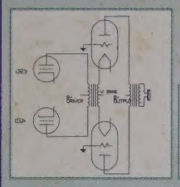

Mark Kelly
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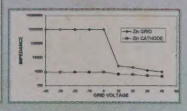

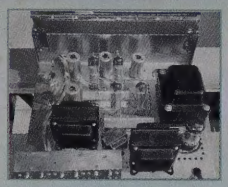

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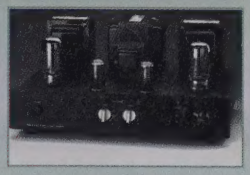

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GLASS AUDIO

SRPP Control Preamplifier

BY MICHAEL BURROWS

PHOTO 1: Preamp component board.

Are you tired of listening to LPs, CDs, and other sound sources recorded using some nonstandard recording equalization or engineered for a bat's hearing? Or what about your early-'50s LP with its less than hi-fi sound that you nonetheless enjoy? And how about those acetate tapes that you made decades ago using a ceramic microphone?

You could use a multiband equalizer, but much of the pleasure of casual listening is lost as you busily turn knobs and push sliders. I have nothing against multiband equalizers; I use one myself for recording poor-sounding recordings to tape. But for casual listening, I prefer a simpler method that most manufacturers have abandoned: tone controls.

Purists may shriek that this is a throwback to a more primitive time, but you designed your sound system for your ears, and if your sound sources are less than perfect, the shunt-regulated push-pull (SRPP) control preamplifier might just be what you need.

to page 10

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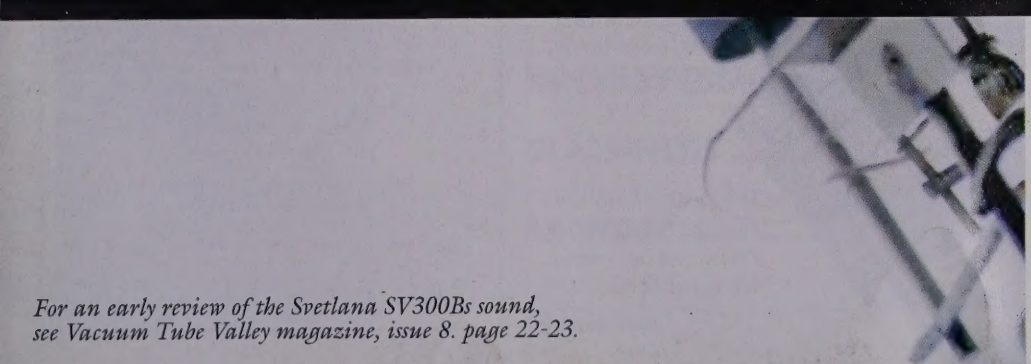

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For an early review of the Svetlana SV300Bs sound, see Vacuum Tube Valley magazine, issue 8. page 22-23.

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Reader Service #20

ABOUT THIS ISSUE

We kick off the new year (our eleventh year bringing you the best in tube-based audio) with a design change to the pages of *Glass Audio*. This new format–different type styles and treatment of accompanying tables, photos, and schematics, and inclusion of a blurb summarizing each inside article's contents–gives the pages a clean, bright look and offers readers easier access to the information presented. The cover also contains a slightly new look, which we trust you'll appreciate; we've removed the table of contents and set it on its own dedicated page inside. This new packaging is our gift to *GA* readers to help you better enjoy the lineup of articles we'll be bringing you this year.

Leading off is, appropriately enough, one of our familiar, hard-working authors, **Michael Burrows**, who's been a big hit with readers in previous issues. His work is based on an extensive amount of designing: a shunt-regulated push-pull preamp design with tone controls that lets you enjoy your favorite recordings on various formats ("SRPP Control Preamplifier," p. 1).

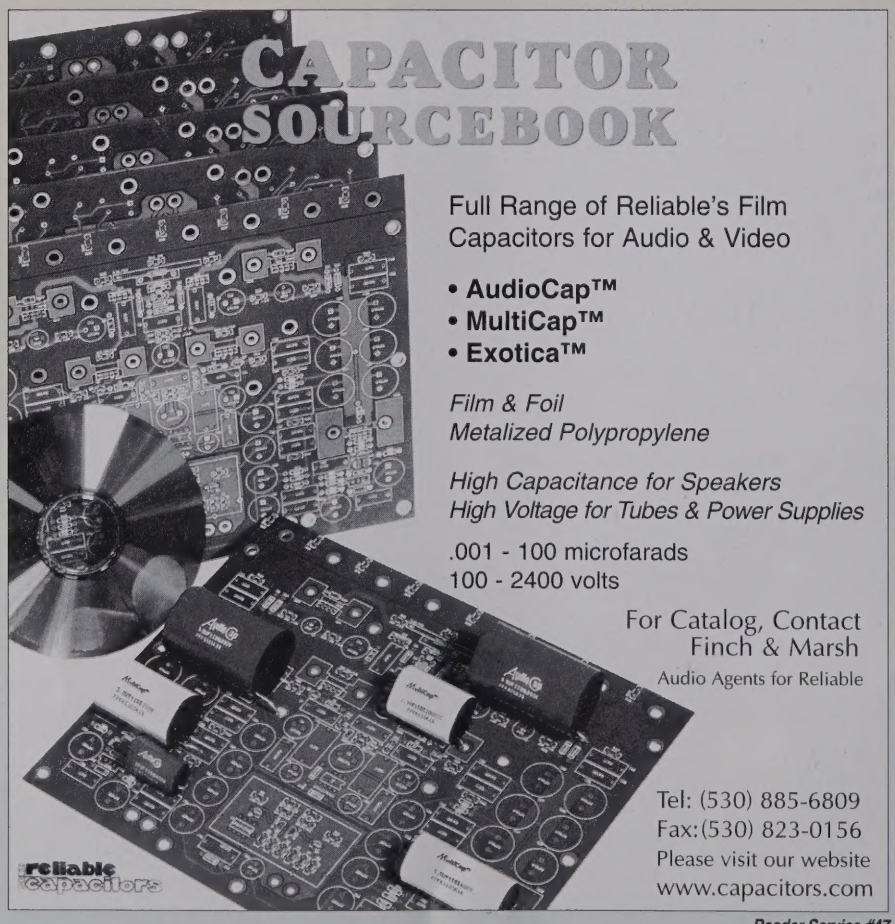
Another favorite among *GA* readers is **Mark Kelly**, who brings us his latest efforts from Australia, the site of much landmark work in audio. He offers a transformer-coupled design that provides new insight in dealing with power triodes ("Transformer-Coupled Cathode-Driven Power Triode," p. 26).

Another familiar name, **Charles Hansen**, is an electronics veteran who uncovers a source of top-quality enclosures at a reasonable price for your DIY projects ("Kit Report," p. 48).

The Old Guard gives way to some fresh approaches offered by two newcomers to the pages of *GA*.

Tom Yeago brings new meaning to the DIY approach with his article on salvaging audio gear from the scrap heap, which can sometimes prove an interesting source of usable parts ("Trolling the Scrapyards," p. 34). So don your hard hat and work boots and join T.D. in his search for electronic gear.

Steve Robertson's first project from scratch is a beautiful restoration project resulting in an all-tube, stereo integrated amp ("I Built an Amp; You Can, Too," p. 38). If you're a would-be builder who doesn't know where to start, this article will point you in the right direction.



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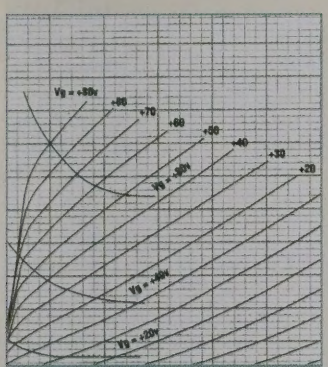
About the Cover
Michael Burrows' SRPP to boost your listening enjoyment.

GLASS AUDIO

Volume 11 Number 1 1999



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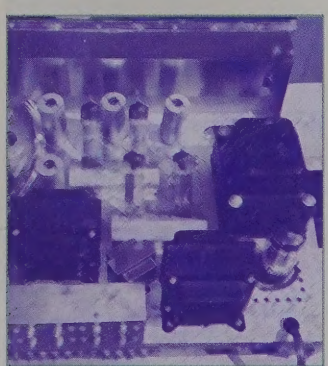

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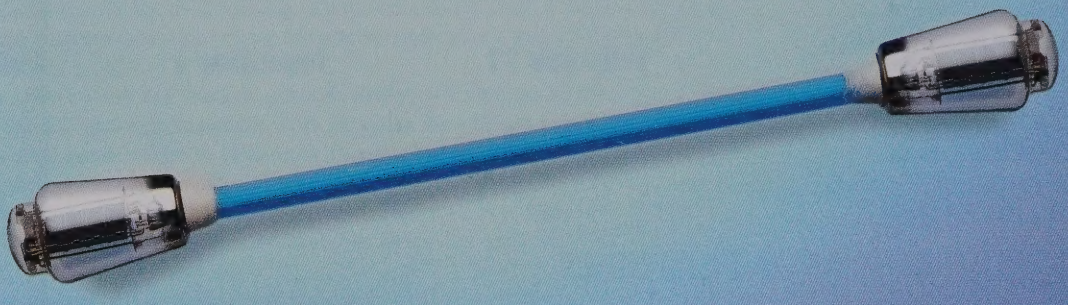

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EDITORIAL

A look back, a look ahead

By Edward T. Dell, Jr.

As we begin a new year with *Glass Audio* after a tenth-anniversary celebration, I thought it might be nice to take time to reflect a bit on where we have been and, to some small extent, try to map where we may be headed in the future. Back in the late eighties I began to notice an increase in manuscripts from authors dealing with vacuum tubes. One of the prime magnets for such was the immensely popular Dynaco Stereo 70 device.

In a phone conversation one day with John Curl, with whom I am privileged to talk on occasion, he mentioned in passing that he still had a Stereo 70 in his power amp collection and now and then connected it to his speakers with surprising satisfaction. As many people know, John has designed amplifiers and other hardware for a wide array of distinguished companies. Our conversation was a kind of catalyst for me, and I began to think in terms of a special publication devoted exclusively to tube (or valve) technology.

We had just folded a three-year failed attempt to publish a computer technology magazine titled *Computer Smyth*. It attracted some surprisingly innovative articles, but the Microsoft/Intel juggernaut was gathering weekly speed and bulk, crushing all before it. I was not convinced that another magazine was a good idea or that anyone would be interested. My technique for a "launch" was more like a creep into the marketplace.

We put together a first, small 32-page sample issue and bundled it with the fourth 1988 issue of *Audio Amateur* (as it was then called). This was a tentative test of the water temperature and carried a nice variety of articles from Joseph Curcio, Charles King, and Ross Giles, and, prophetically, two offerings from authors overseas—Helmut Becker and Michael Obersch for a tubed headphone amp, and Ken Kessler with an overview of the growing popularity of vacuum tubes.

Like *Speaker Builder,* launched eight years previously, *Glass Audio* was really another "organ donor" operation, taking another "rib" from the original patient, *Audio Amateur*. I received a lot of mail from worried subscribers wondering whether *AA* would survive yet another surgery. I had similar thoughts myself, but I recalled that such predictions had been plentiful when *Speaker Builder* was launched in 1980.

I kept in mind that before *Speaker Builder* was published, we averaged about 2.5 speaker technology articles annually in *Audio Amateur*. In the first year of *SB* some 15 new authors appeared, and we published 16 articles, and numbers of other smaller pieces. Major voices about speakers turned up that first year in the persons of Robert Bullock, Siegfried Linkwitz, and Bruce Edgar. They were quickly followed by many others who over the two decades since have made major contributions to the art and science of building loudspeakers.

This gave me considerable confidence that a special publication dedicated to vacuum tube audio would have the same effect. This has proven to be correct, and just as rewarding in *Glass Audio*'s ten-year history. Somehow, narrowing the focus of a publication intensifies the interest and enthusiasm of both those who contribute as authors and those who subscribe.

The most surprising development of this decade of publishing, however, is one I could never have imagined. Although we began the decade with a major revival of interest in the Williamson circuitry, mostly represented by Dynaco's popular Mark III and Stereo 70 designs, the orthodoxy of the Williamson design was quickly challenged, and quickly faded in popularity. Since that began to happen, there has been a wild melee of searching the literature for designs pre-dating Williamson and push-pull design. The slogan of those engaged in massive archaeological digs through the past has been, "Let's try *everything* and see what it sounds like!"

Two other wonderful developments have been charging and recharging the enthusiasms of readers and authors alike. First of all the manuscripts have been turning up from all over the world. Almost 25% of those who subscribe to *Glass Audio* live outside North America. The conversation has become international, which is, in an age where communication is easier and faster than at anytime in history, not very surprising. Italian, French, Dutch, Japanese, Swedish, and Finnish readers and authors are well represented—among many, many others, an increasing number from this hemisphere.

As I write this, our new 1999 version of *The World Tube Directory* is just about to be mailed. If any further evidence of the solid growth of interest in tube technology were needed, this newest and largest edition of this annual publication would be all that would be required.

As we begin a second decade I am deeply grateful to you all for participating in what has been a very exciting journey. I welcome your continuing participation as authors, as those offering ideas and questions, as well as those offering answers, suggestions, insights, and experience. It is this interactive, sharing work which has made *Glass Audio* useful, innovative, and informative. We will try to continue to serve you in the manner which you deserve.—E.T.D. ■

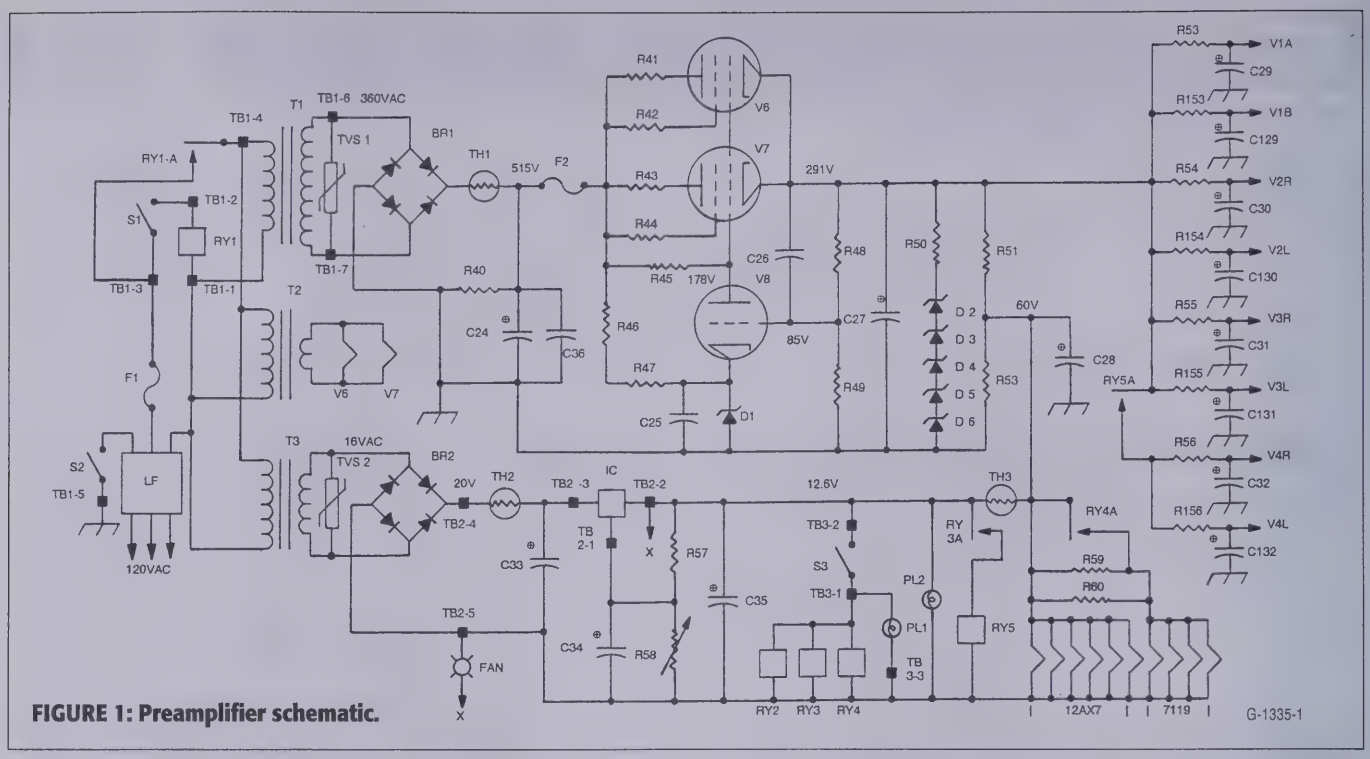

FIGURE 1: Preamplifier schematic.

from page 1

FEATURES

The SRPP circuit (*Fig. 1*) has been described and debated in many past issues of *Glass Audio*.[1] Although there are more advanced designs, it's hard to beat the SRPP for simplicity and great sound.

The preamplifier consists of two stages of gain, with feedback bass and treble controls that provide ±20dB boost/cut, as well as a shelving midrange switch with a range of 0 to –6dB in 1dB steps. An active tape buffer provides complete isolation between the source and preamplifier proper, and there is an SRPP headphone amp that uses the 7119/ E182CC dual triode. *Table 1* shows the preamp specifications, and *Table 2* is the parts list.

Unlike my last project[2], which had a vast amount of wiring, this SRPP preamp is about 95% free of wiring. With the exception of two transformers, a headphone jack, three switches, a line filter, three solid-state components, and the input and output jacks, everything mounts on a 12″ × 12″ circuit board (*Photos 1* and *2*). Three terminal blocks (*Fig. 2*) provide a number of external connections, making it easier to remove and replace the circuit board.

TABLE 1
PREAMP SPECIFICATIONS

Input sensitivity (ref 1V)	0.16V
Maximum output	10V
Frequency response (ref 1V)	15Hz–65kHz +0, –0.5dB
THD + noise (ref 1V, 1kHz)	0.03%
Bass control range	±20dB @ 50Hz
Treble control range	±20dB @ 12kHz
Midrange switch	±0, –6dB @ 900Hz

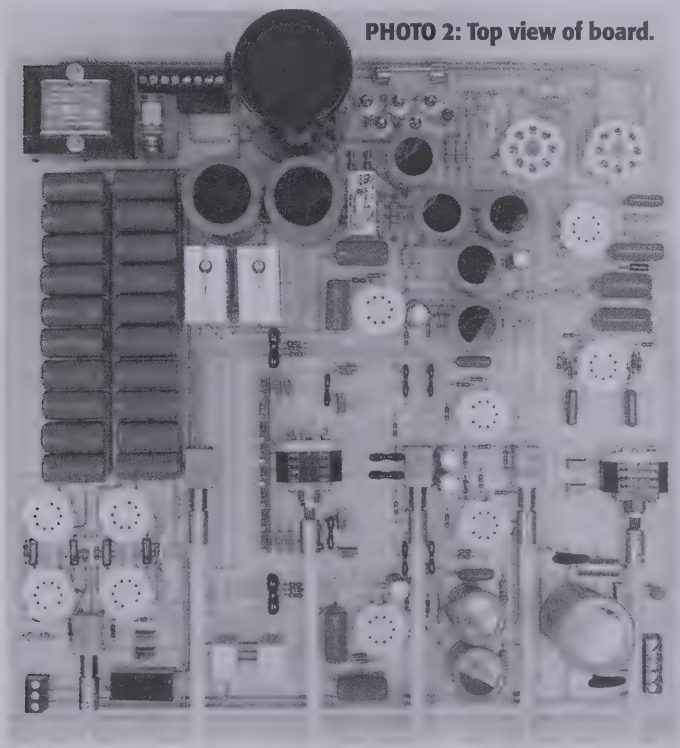

PHOTO 2: Top view of board.

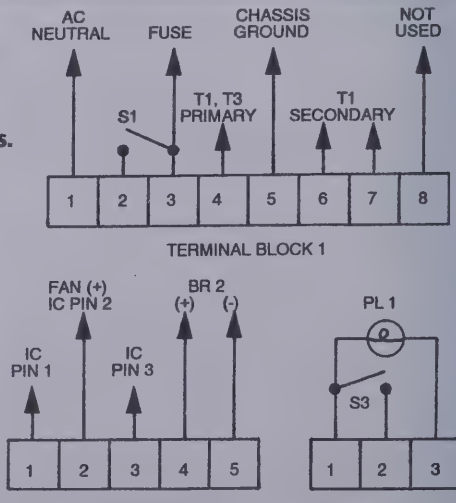

FIGURE 2: Terminal-block connections.

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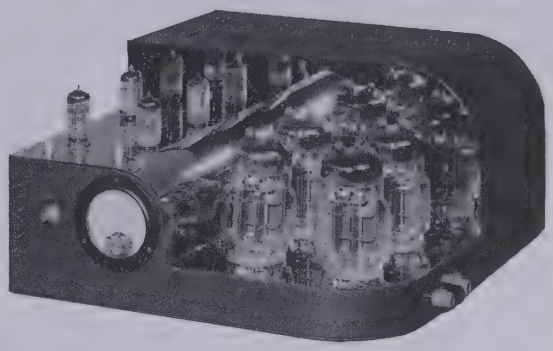

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"I would like to express my deepest regards to you and your team. Harvey [Rosenberg] was indeed right when he stated that you are going to create a revolution with your designs. One of my friends who is a very critical person... and extremely difficult to satisfy, was overwhelmed by the M-60 Mk. II. He called me the day after to say that he was dreaming about the amps the whole night! The most fantastic experience I had myself was when I removed all but 2 of the 6AS7s and drove my Lowthers with them. It should be stated that I do not normally get overly enthusiastic about amps. During the last decade many have passed through here. But this was really extraordinary... I must admit that it was the greatest musical experience that I have ever had." *Patrik K. —Distributor— Sweden*

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"...brought tears to my eyes again last night. Thank you for my latest revelation in high-end audio." *Mike H. —Customer— NJ*

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CIRCUIT DESCRIPTION

The buffered tape (or recordable CD) output consists of a 12AX7 self-biased cathode follower, with its high input impedance preventing signal sources from being loaded down. The input and output stages are 12AX7s, SRPP-connected, and the cathode of the lower section is bypassed. My reason for doing this was to lower the output impedance and provide a little extra gain. V2 drives the bass, midrange, and treble controls, all of which operate in a feedback (Baxandall) circuit, which includes V3.

The midrange switch operates at 900Hz, with a slope of 6dB per octave. I experimented with numerous designs, including slopes of 12, 18, and 36dB per octave. Unfortunately, these sharp-cutoff filters introduce a great deal of phase-shift that adds a certain sonic unpleasantness to the sound. C7 bypasses low frequencies, while C8 bypasses high frequencies. I used 12-turn trimmers because it's impossible to obtain resistors in these oddball ranges. I left out the balance control for two reasons: most people (including my-

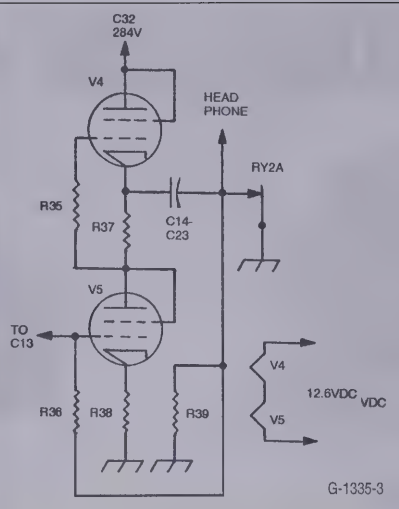

FIGURE 3: Triode-connected 6BQ5/ EL84 version.

TABLE 2
PREAMPLIFIER PARTS LIST (ONE CHANNEL)

CAPACITORS	DESCRIPTION	MANUFACTURER/PART #/(SOURCE)
C1	0.1µF	630V Cornell Dubilier (CD) DME6P1k (6,7)
C2, C10, C12	4.7µF, 250V	CD DME2W4P7K (6,7)
C3	0.68µF, 250V	CD DME2P68K (6,7)
C4, C11	1000µF, 10V	Philips (PH) 136.64102 (2)
C5, C9	390pF, 500V mica	CD FD391J03 (6,7)
C6	10,000pF, 5000V mica	CD FD103J03 (6,7)
C7	470pF, 500V mica	CD FD471J03 (6,7)
C8	1200pF, 500V mica	CD FD122J03 (6,7)
C13	1.0µF, 100V	CD DME1W1K (6,7)
C13–22	10µF, 250V	CD DME2W10K (6,7)
RESISTORS		
R1, R29, R34	1k	PH MRS25 (4)
R2, R9, R28, R35	1M	PH MRS25 (4)
R3, R11	1.8k	PH MRS25 (4)
R4, R32	10k, 25T trimmer	Bourns (BO) 3296W (4,7)
R5	47k	PH MRS25 (4)
R6, R33	100k audio taper cermet	Clarostat L12566 (9)
R7, R10, R39	100k	PH MRS25 (4)
R8	6.8k	PH MRS25 (4)
R14, R18	15k	PH MRS25 (4)
R15, R17	500k linear taper cermet	Clarostat L12565 (9)
R16, R36	120k	PH MRS25 (4)
R36 (6BQ5/EL84 version)	62k	PH MRS25 (4)
R19	500k, 25T trimmer	BO 3296W (293.3k) (4,7)
R20	100k, 25T trimmer	BO 3296W (67.4k) (4,7)
R21	100k, 25T trimmer	BO 3296W (60.4k) (4,7)
R22	50k, 25T trimmer	BO 3296W (49.9k) (4,7)
R23	50k, 25T trimmer	BO 3296W (45k) (4,7)
R24	50k, 25T trimmer	BO 3296W (33k) (4,7)
R25	50k, 25T trimmer	BO 3296W (23k) (4,7)
R26	220k	PH MRS25 (4)
R27	20k, 25T trimmer	BO 3296W (4,7)
R30, R31	510	PH MRS25 (4,7)
R37, R38	75, 3W wirewound, 5%	Ohmite 23J75R (3)
R37, R38 (6BQ5/EL84 version)	120, 3W wirewound, 5%	Ohmite 23J75R (3)
R40	10k, 1W, 5%	Panasonic (3)
SWITCHES		
S1	2 pole, nonshorting	Electroswitch C3P0212N-A (7)
S2	4 pole, shorting	Electroswitch C3P0406S-A (7)
VACUUM TUBES		
V1–V3	12AX7	RAM/Chelmer (2,4)
V4, V5	7119/E182CC	Amperex (1,8)
	6BQ5/EL84	Sovtek (1,8)

TABLE 3
7119/E182CC SPECIFICATIONS

MAXIMUM RATINGS:	
Heater voltage	6.3/12.6V
Heater current	640/320mA
Maximum plate voltage	300V
Plate dissipation (per section)	4.5W
Plate dissipation (both sections)	8.0W
Maximum cathode current	60mA
TYPICAL OPERATION:	
Plate voltage	120V
Grid voltage	–2V
Plate current	36mA
Plate resistance	1.56kΩ
Transconductance	15,000 µmhos
Amplification factor	24

TABLE 4
HEADPHONE SPECIFICATIONS

7119/E182CC VERSION:	
	MAXIMUM OUTPUT (W)
100Ω	2.6
300Ω	1.8
600Ω	1.3
	THD + NOISE (REF. 100mW, 1kHz)
100Ω	0.1%
300Ω	0.08%
600Ω	0.3%
Frequency response (ref. 100mW):	18Hz–52kHz, +0, –0.25dB
6BQ5/EL84 VERSION:	
	MAXIMUM OUTPUT (W)
100Ω	0.2
300Ω	0.4
600Ω	0.8
	THD + NOISE (REF. 100mW, 1kHz)
100Ω	1.3%
300Ω	0.4%
600Ω	0.5%
Frequency response (ref. 100mW):	24Hz–52kHz, +0, –0.25dB

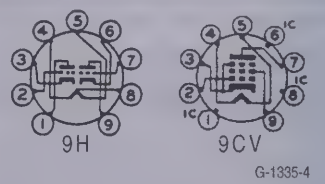

FIGURE 4: Connections for the 7119/ E182CC (top) and 6BQ5/EL84 (bottom) tubes.

ABOUT THE AUTHOR

Michael Burrows' interest in electronics began in his teens, when he was a junior in high school and worked part-time in an audio-repair shop. During that time, he built a single-ended 807 power amplifier, as well as Heathkits. In the early '70s he worked as an independent audio/TV technician. He has many hobbies, but has never lost interest in electronics and in listening to Baroque organ music through a good vacuum-tube amplifier.

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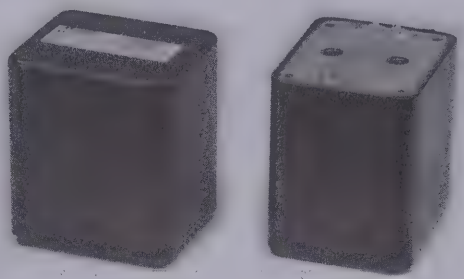

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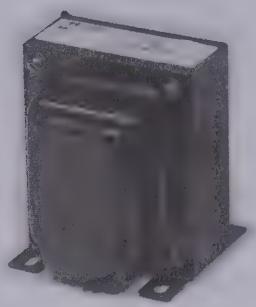

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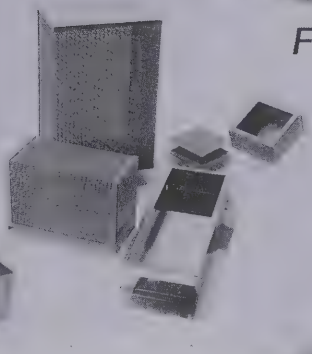

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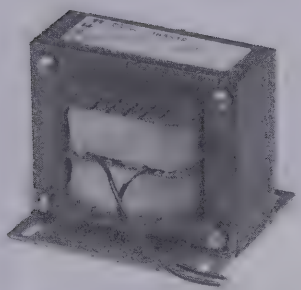

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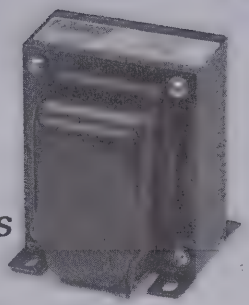

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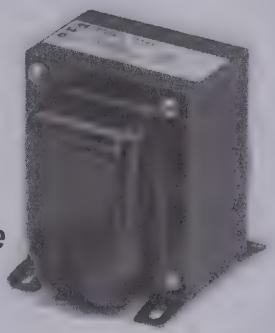

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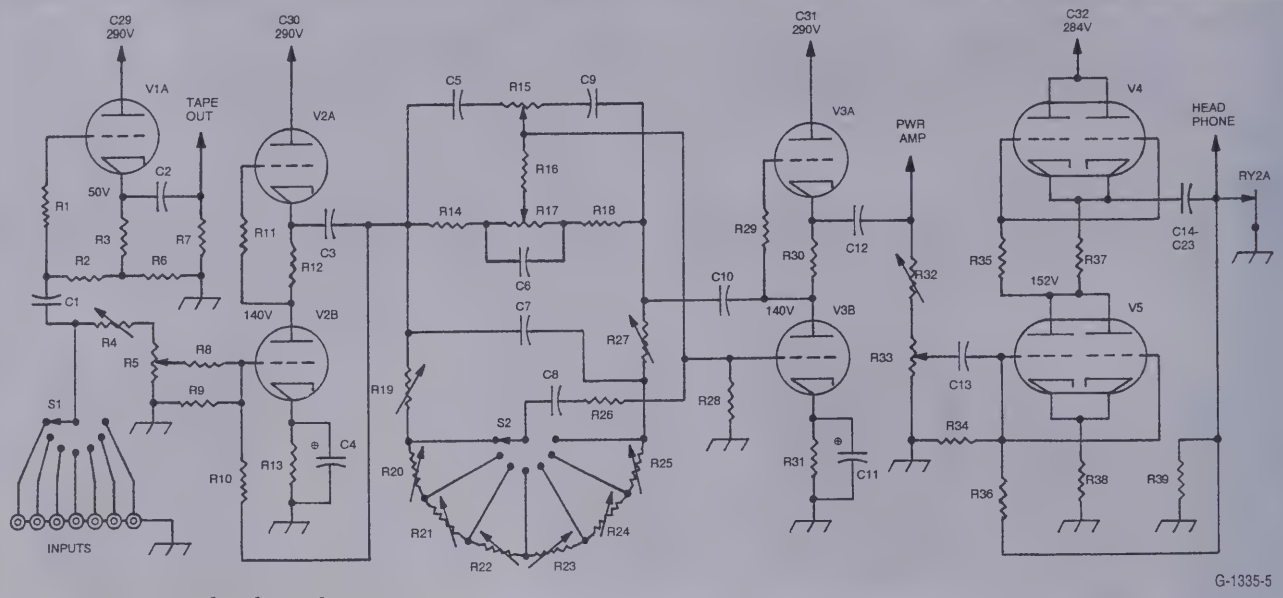

FIGURE 5: Power-supply schematic.

TABLE 5
POWER SUPPLY PARTS LIST

PART		MANUFACTURER/PART NUMBER
CAPACITORS		
C24	470µF, 600V	Aerovox ALS30A471KF600 (4)
C25	2.2µF, 250V	CD DME2W2P2K (6,7)
C26	0.1µF, 630V	CD DME6P1K (6,7)
C27, C29, C30, C31	100µF, 385V	PH 057 58101 (4)
C28	22µF, 200V	PH 044 62229 (4)
C32	330µF, 385V	PH 059 58331 (4)
C33	22,000µF, 25V	PH 058 56223 (4)
C34	100µF, 20V tantalum	Mallory #TDC-107K020WSG (7)
C35	100µF, 20V tantalum	Mallory #E107KM (7)
C36	10,000pF, 3kV, ceramic	Sprague 30GAS10 (7)
FUSES		
F1	3A, time delay	Bussman MDL (3,6,7)
F2	1/10A, time delay	Bussman MDL (3,6,7)
LINE FILTER		
LF1	10A	Corcom 10ED1C (3)
LAMPS		
PL1	12V, T1, bi-pin	C&K 1.90180.472 (7)
PL2	12V, T4.5 slide base	C&K 1.90100.022 (7)
RELAYS		
RY1	SPDT, 10A, AC coil	Omron #G2R-1 (4)
RY2, RY3	DPDT, delay-on-operate 12V DC coil	Magnecraft #W67CPSOX-1 (7)
RY4	SPST, 16A, 12V DC coil	Siemens #V23077-A1005-A402 (4) 300V DC rated contacts
RY5	SPDT, 16A, 12V DC coil	NTE #R22-1D16-12 (6)
RESISTORS		
R41	430k, 2W	Panasonic (PAN) (3)
R42, R44	150, 3W, 5% wirewound	Ohmite 93J150 (3,7)
R43, R45	1.5k, 1W, 5%	PAN (3)
R46	430k, 1W, 5%	PAN (3)
R47, R48	220k, 1W, 5%	PAN (3)
R49	300k, 1W, 5%	PAN (3)
R50	130k, 1W, 5%	PAN (3)
R51	40, 10W, 5% wirewound	Ohmite 20J40R (3,7)
R52	270k, 1W, 5%	PAN (3)
R53	68k, 1W, 5%	PAN (3)
R54	2k, 1W, 5%	PAN (3)
R57	150, 2W, 5%	PAN (3)
R58	100, 2W, 5%	PH PR02 (4)
R59	1k, 25T trimmer	BO 3296W (4,7)
R60, R61	5k, 10W, 5% wirewound	Dale CPCC-10 (7)
TH1	47Ω @ 25°C, 3A, NTC	Keystone CL-80 (3,7)
TH2, TH3	0.7Ω @ 25°C, 12A, NTC	Keystone CL-10 (3,7)
SEMICONDUCTORS		
BR1	8A, 1000V rrm	NTE 5317 (6)
BR2	25A, 100V rrm	IR 26MB10A (4)
D1	91V, 5W, 5% zener	Motorola 1N5377B (7)
D2–D5	75V, 20W, 5% zener	Semitron BZY93C75 (4)
D6	51V, 20W, 5% zener	Semitron BZY93C51 (4)
IC1	7.5A adjustable	Linear Technology LT1083CP (4)
TVS 1	385V AC MOV	Siemens B32K385 (or Harris DA series)
TVS 2	20V AC MOV	Harris V33ZA5 (7)
SWITCHES		
S1	Pushbutton, latching	C&K 1.15108.552 (7)
S2	10A, SPDT	C&K D501J12S215PQF (7)
S3	Pushbutton, latching	C&K 1.15116.011 (7)
TERMINAL BLOCKS		
TB1	8 pole, 0.2″ spacing	Beau 880508 (7)
TB2	5 pole, 0.2″ spacing	Beau 880505 (7)
TB3	3 pole, 0.2″ spacing	Beau 880503 (7)
TRANSFORMERS		
T1	360V @ 250mA	Hammond 263CX (7)
T2	6.3V AC @ 2A	Stancor SW-512 (7)
T3	16V AC @ 8.1A	MagneTek VPS16-8100 (7)
VACUUM TUBES		
V6, V7	5881	Sovtek (1,8)
V8	½ 12AX7	Chelmer (4)
MISCELLANEOUS		
Brass couplings (6)		Radiotron-Elma (4)
Cabinet-rack (1)		Bud RM-14213 (7)
Cabinet-top/bottom (2)		Bud TBC-14252 (7)
Chassis plates (2)		Bud C14243 and C14245 (7)
Circuit board, 2 oz copper (1)		Kepro DF12-1212G (5)
Circuit board spacers (16)		SPC Technology 2625 9 (7)
Fan (see text) (1)		Papst 3312L (7)
Heatsink (see text) (1)		IMI Marston 44DN01000A200 (4)
Knobs (6)		Welborne Labs K175B (10)
Nylon rods		DSM EPP (4)
Tube sockets, PC type:		
9-pin, gold-plated pins (10)		New Sensor (8)
octal, gold-plated pins (2)		New Sensor (8)

Note: All resistors are 0.6W, metal film unless otherwise stated.

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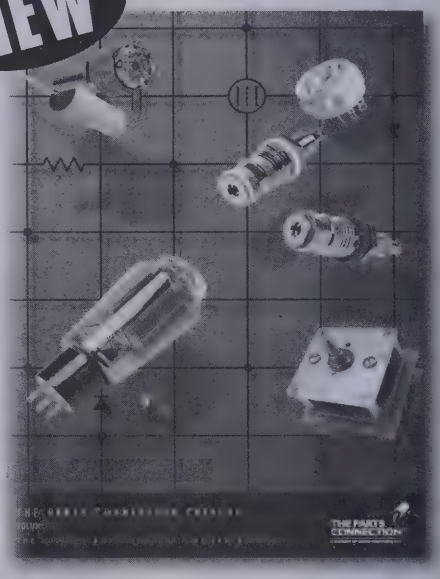

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52591	E88CC/6922	Dual Triode	Mullard	$22.50 ea.
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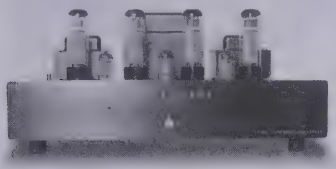

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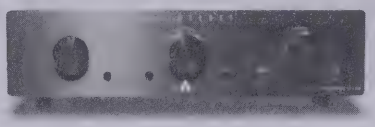

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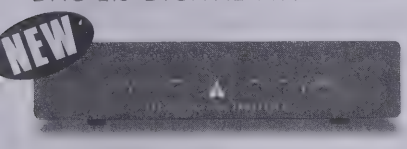

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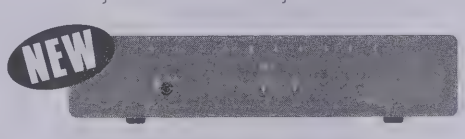

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From page 14

FIGURE 6: Circuit-board design for the 7119/E182CC version.

self) never use them, and it's just something else to degrade the sound.

The headphone section uses the 7119/E182CC high-perveance twin triode that was designed for computer circuits. You can think of this tube as a supercharged 6SN7, with its 4.5W per section plate-dissipation rating, that makes a great headphone driver when paralleled. Eric Barbour, a regular contributor to *Glass Audio*, produced an excellent dissertation on the 7119/E182CC and similar tubes.[3] *Table 3*[4,5] shows the specifications.

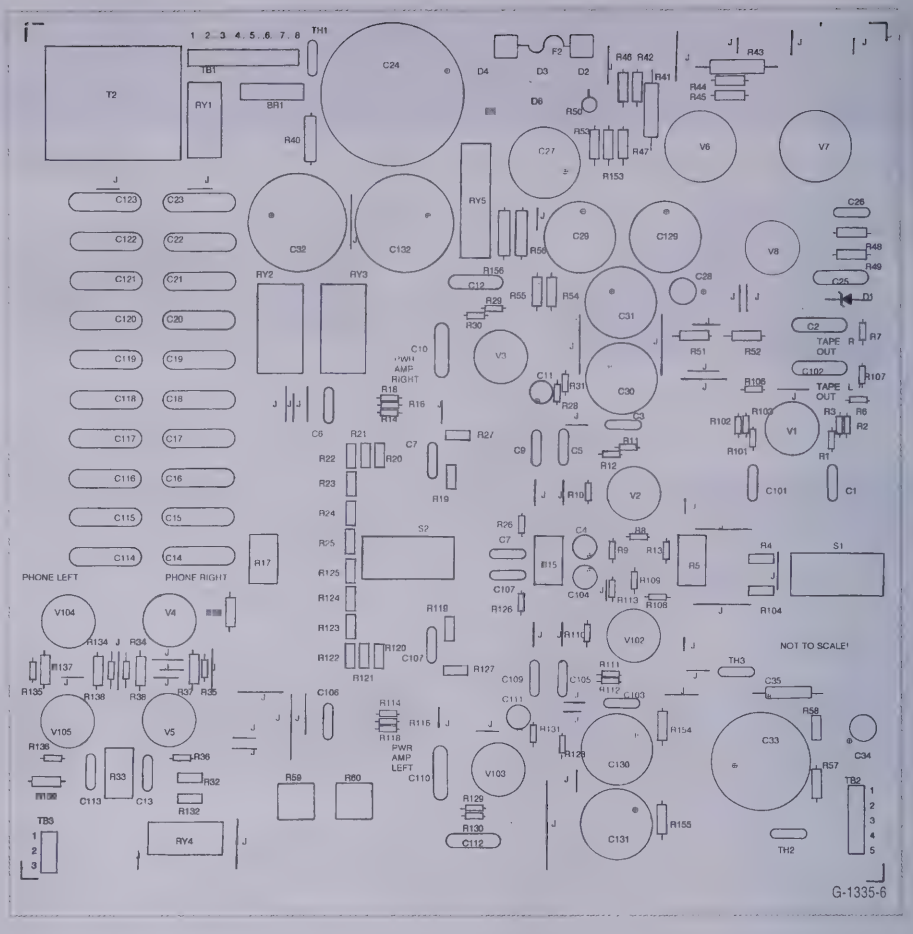
I really don't know whether anyone is still making the 7119/E182CC or, if not, how long the supply will last, so I also have a triode-connected 6BQ5/EL84 version. Though it cannot produce a great deal of power, it will drive most headphones to extremely loud levels (*Fig. 3*). Both versions invert the signal, but this isn't a problem in home use. *Figure 4* shows the connections for the 7119/E18 2CC and 6BQ5/ EL84 tubes.

I designed the headphone amp for headphones with an impedance of 100Ω or higher. If you have headphones with a lower impedance, you will need to use a 300–600Ω matching transformer. The specifications of both headphone-amp versions are listed in *Table 4*. This is not to say that either version can't be used with 8Ω headphones; it can, but distortion rises rapidly with loads of less than 100Ω.

POWER SUPPLY

The power supply (*Fig. 5* is the schematic and *Table 5* the parts list) consists of T1, a 360V CT, 250mA transformer designed for a full-wave rectifier, but since it is used with a bridge rectifier, the maximum current rating drops to about 140mA. The 5V rectifier winding isn't used. The rectified output goes to paralleled 5881s, which might sound like overkill in a preamp, but the headphone section consumes about 90mA. You can use a single 6550/KT88, but then you must make some adjustment to voltage-control resistors R49 and R50. Zener diodes D2–D6 are 20W units that provide overvoltage protection. Transformer T2 supplies filament power for the 5881s, and T3 does so for the 12AX7s, 7119s, and relays.

Relay RY1 switches not only the preamp, but also the switched AC receptacles on the back panel. Pushbutton



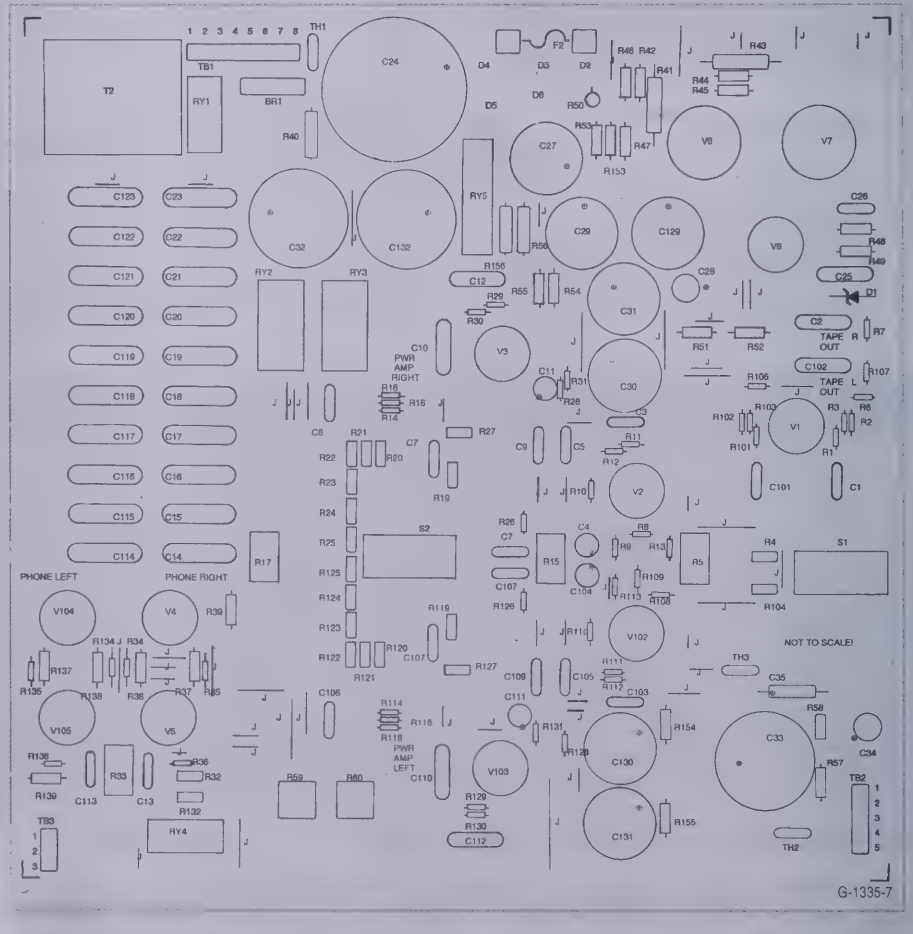


FIGURE 7: Circuit-board design for the 6BQ5/EL84 version.

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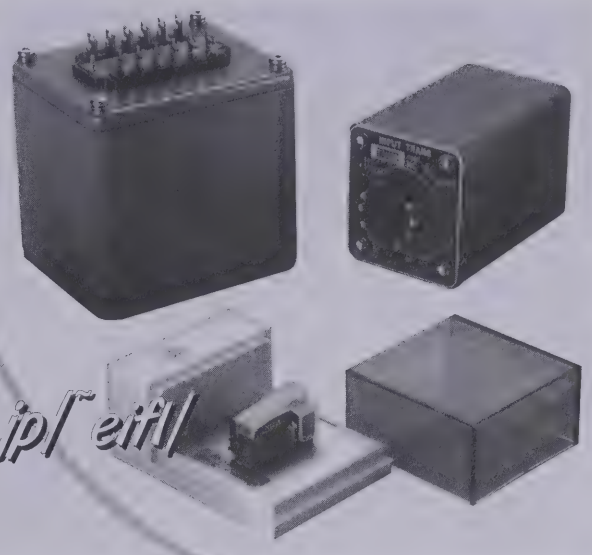

■Cartridge

Model	Price (US $)	Postage (Air Economy)	
Denon DL-102 (MONO)	150	Area I $18	China, Korea Hong Kong Taiwan
Denon DL-103 (STEREO)	160	Area II $22	Singapore Malaysia Indonesia
Denon DL-103R (STEREO)	250	Area III $27	North America Oceania Europe
Shelter Model 501 II (Crown Jewel)	650	Area IV $34	Africa South America
Ortofon SPU Classic GE	630		

■Japanease Audio Book

Title	Price (US $)	Postage* (Air Economy)	
Attractive Tube Amps Vol. 1&2 (Isamu Asano)	30 each	Area I $10	Asia
Joy of Vintage Tube Amps (Tadaatsu Atarashi)	28	Area II $9	North America Europe Oceania
JBL Moniter Speakers (Stereo Sound)	23	Area III $8	Africa South America
MJ Selected 300B Amps	21		
Audio Tubes(Hisashi Ohtsuka)	35		
SE Amps by Transmitting Tubes (Kouichi Shishido)	50		

These Area I ~IV are for all products except book.

* These Area I, II, III are for book only.

■Speaker

Model	Specifications					Price*	Postage** (US $)			
	D(cm)	Ω	Response	db	w	(US $)	I	II	III	IV
Fostex FE208 Σ	20	8	45Hz~20kHz	96.5	100	296	62	74	120	156
Fostex FE168 Σ	16	8	60Hz~20kHz	94	80	236	42	50	73	98
Fostex FE108 Σ	10	8	80Hz~18kHz	92	15	144	30	36	50	66
Onken OS5000T	—	8	7kHz~25kHz	105	2.5	2,800	70	84	133	181
STAX SR-001	S-001 Ear Speaker+SRM-001 Drives Unit					248	24	29	39	50

*Price is for a pair except SR-001. **Air Economy

■Tonearm

Model	Specifications	Price (US $)	Postage* (US $)			
			I	II	III	IV
Ikeda IT345	・Dynamic Balanced Type ・Length IT345 245mm IT407 307mm ・Stylus Pressure 0~5g	1600	24	29	39	50
Ikeda IT407		1800	30	36	50	66

*Air Economy

■Transformer

Model (SE OPT)	Specifications				Price*	Postage** (US $)			
	W	Pri.Imp(kΩ)	Freq Response	Application	(US $)	I	II	III	IV
Tango XE-60-5SNF	30	5	25Hz~70kHz	300B, 50, PX-25	612	62	74	115	156
Tango XE-20S	20	2.5, 3.5, 5	20Hz~90kHz	300B, 50, 2A3	384	47	56	84	113
Tango FW-150-10SR	40	10	25Hz~35kHz	211, VT-4C	940	76	92	147	201
Tango NY-15-3.5S (45% Permalloy)	15	3.5	20Hz~45kHz	300B, 50 2A3	876	62	74	115	156
Tango U-808	25	2, 2.5, 3.5, 5	20Hz~65kHz	6L6, 50, 2A3	238	42	50	73	98
Tango X-5S	40	5	18Hz~70kHz	50, 845	1074	79	96	154	211
Tamura F-7001 (Permalloy)	8	3	15Hz~60kHz	300B,2A3	650	42	50	73	98
Tamura F-7003 (Permalloy)	10	5	15Hz~50kHz	300B,50	760	42	50	73	98
Tamura F-2013	40	10	20Hz~50kHz	211,VT-4C	730	57	68	105	142

*Price is for a pair. ** Air Economy

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Reader Service #78

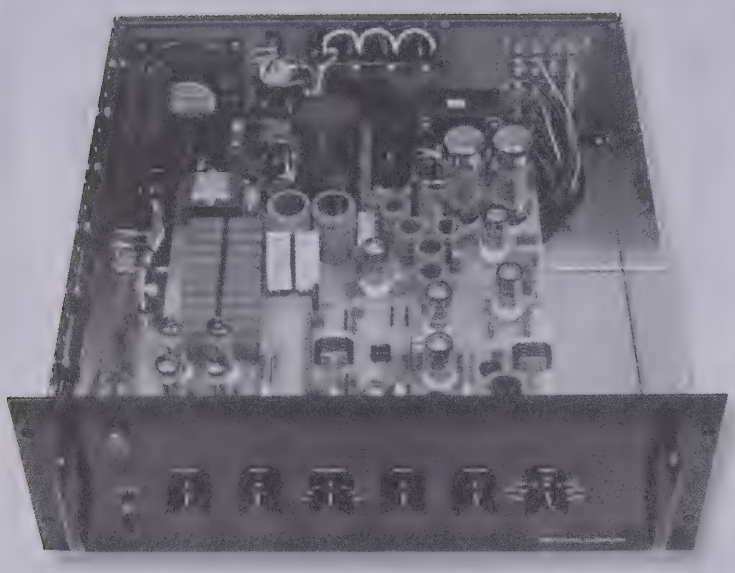

PHOTO 3: Circuit board inside the chassis.

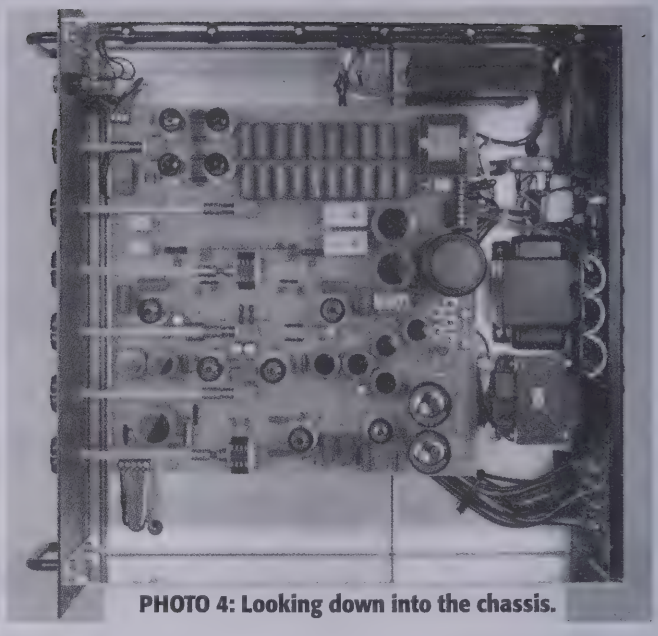

PHOTO 4: Looking down into the chassis.

switch S3 activates the headphone section. RY4 bypasses R60 and R61, allowing full voltage to the 7119 filaments. RY2 is a time-delay relay (set to 30 seconds) that mutes the output and allows the capacitors to charge. RY3 is also a time-delay relay, set to 25 seconds. This relay energizes RY5, which in turn supplies voltage to the 7119 plates.

The IC I used will dissipate about 40W, and normally would require a massive and expensive heatsink rated at 0.35°C/W. I chose, however, to use a relatively small heatsink, rated at 1.2°C/W, and a low-noise fan to keep everything cool. Finally, there is a ground lift switch, should you encounter ground-loop problems.

CONSTRUCTION HINTS

If you are following my circuit-board design, insert the jumpers—53 in the 7119 version (*Fig. 6*) and 54 in the 6BQ5 (*Fig. 7*)—and small parts first. Many small parts are very close to large parts, and you would have difficulty inserting them later.

To avoid possibly delaminating the circuit board, mount the hot-running thermistors about one inch above the board. There is no need to use a heatsink on zeners D2–D6; they operate in transient mode.

Be careful while installing the two tantalum capacitors. These high-perfor-

ADDITIONAL CONSTRUCTION NOTES

If you are using my circuit-board design, the following construction information will be helpful to reduce the possibility of errors.

After etching the circuit board, I strongly recommend you purchase a Dremel® Moto-Tool® and #212 drill press to drill the holes in the board. I use it all the time for circuit-board work, but the drill press has a limited base and drilling range, so I do the following.

Remove the rack assembly, mount the base upside down to a piece of furniture such as an old chair, and then position the chair on your desk or workbench. Remount the rack assembly, insert the Moto-Tool, and then place the circuit board on a telephone book or the like to achieve the proper working height. This arrangement provides an ideal support for the circuit board and allows you to perform all types of drilling or milling operations.

I use Kepro's solid-tungsten drill bits designed for circuit boards. They are, however, extremely brittle, so use the highest possible speed when drilling, and be careful not to move the circuit board, since the smaller bits can easily snap in two. The drill bits I used are:

#70—for film resistors and trimmer resistors
#65—for rotary switches, small electrolytics and poly caps, tantalums, pots, and jumpers
#60—for large poly caps, D1, and mica caps, except for C6
#57—for terminal blocks, 1–2W metal-oxide resistors, the C6 mica cap, and coil connections on RY5, R59, and R60
#55—for RY2 and RY3 sockets
#54—for RY1, RY4, RY5 HV connections, BR1, F2 clips, thermistors, and T2
#50—for 9-pin tube sockets
#45—for octal tube sockets and large electrolytics

Drilling Other Holes

Drilling holes for the C24, the power zeners and the two mounting holes for T2 involves two steps. First, use a #45 drill to make the hole, then use a hand reamer to enlarge it. I strongly advise against using a rotary rasp, as it can suddenly "hang up" on the board, tearing up the copper and possibly removing a finger as well!

Transformer T2 is designed for circuit-board mounting, but I was uneasy about having a fairly heavy object secured by only six pins, so I used the two holes provided in the transformer to mount it, using #8-32 screws with fiber shoulder washers, since the screw heads are very close to the terminals. But the choice is up to you. Ceramic bypass capacitor C36 is soldered to the copper foil as close as possible to C24—and be sure to use compression washers on C24.

A note about the two time-delay relay sockets: These 6-pole sockets have 22 pins, most of which aren't used, and some sockets you buy may or may not have a ground pin. Normally the threaded screw in the relay contacts this pin, but the people at Magnecraft assured me that when you're using these relays on a circuit board, there is no need to have a ground pin. The only time the ground screw is used is in chassis mounting, so don't worry about it.

If you are building the 6BQ5/EL84 version (*Fig. 7*), pin #6 of the tube socket is not used; just drill a hole in the circuit board, and don't solder that pin. —**MB**

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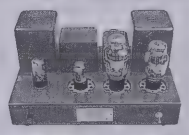
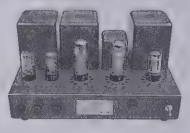


NEW ITEM SV-300BTE
- Power 8W
- Tubes 300B : 1 6SN7GT : 1 6V6GT : 1 5U4G : 1



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- Power 5W + 5W
- With 3 INPUT, REC IN and REC OUT terminals
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SV-300B MKII
- Power 20W, with Interstage Transformer
- Tubes 300B : 2 6SN7GT : 1 5U4G : 1

SV-2A3PE
- Power 15W, with Interstage Transformer
- Tubes 2A3 : 2 6SN7GT : 1 5U4G : 1

SV-KT88PE
- Power 30W, with Interstage Transformer
- Tubes KT-88 : 2 6SN7GT : 1 5U4GB : 1

SV-6L6PE
- Power 20W, with Interstage Transformer
- Tubes 6L6GC : 2 6SN7GT : 1 5U4GB : 1

SV-300BSM
- Power 8W, with specially manufactured OPT
- Tubes 300B : 1 6SN7GT : 1 5U4G : 1
- Chemical Condenser less Circuit

SV-2A3
- Power 3.5W × 3.5W
- Tubes 2A3 : 2 6SN7GT : 2 5U4G : 1

SV-KT88
- Power 8W × 8W
- Tubes KT88 : 2 6SN7GT : 2 5U4GB : 1

SV-300BE
- Power 8W × 8W
- Tubes 300B : 2 6SN7GT : 2 5U4G : 1

SV-6V6SE
- Power 4.5W × 4.5W
- Tubes 6V6 : 2 6N7GT : 2 GZ34 : 1

SV-EL34SE
- Power 8W × 8W
- SV-6V6SE KIT and additional following parts for upgrade.
  Tubes EL34 : 2 pcs Resistors : 3 items Name plate

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- Tubes ECC83 : 1 ECC82 : 5 6X4 : 1

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- Tubes ECC82 : 2 6X4 : 1
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- Tubes 12AX7 : 2 6X4 : 1

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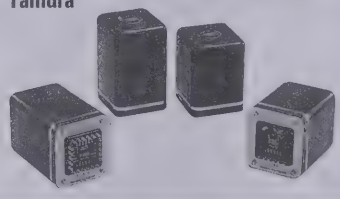

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Reader Service #46

PHOTO 5: Amplifier front panel.

PHOTO 6: Back of the unit.

TABLE 6
PRICE LIST

$186.00	Rack enclosure, chassis plates, top/bottom covers
275.00	Capacitors
42.00	Circuit board & reversing film
14.00	Heatsink
48.00	Knobs
50.00	Phono plugs/jacks
132.00	Potentiometers
144.00	Relays & sockets
82.00	Resistors
103.00	Semiconductors
100.00	Switches
103.00	Transformers
100.00	Tubes
26.00	Tube sockets
400.00	Miscellaneous (hardware, wire, etc.)
80.00	Red oak cabinet
$1885.00	TOTAL

mance capacitors can be instantly ruined by the briefest polarity reversal. Mount the input/output jacks on a piece of copperless epoxy circuit board, and connect all grounds only at this point. Make sure you purchase an insulated phone jack to avoid ground loops.

In order to maximize heat transfer, I did not place an insulator between the IC and the heatsink, so be sure to insulate the heatsink to prevent it from contacting the chassis. Be aware that the output terminal has about 60V DC on it with respect to ground. You can mount bridge rectifier BR2 directly on the chassis. Use 14-gauge (minimum) stranded wire for connections between T3, BR2, the IC, and terminal block TB2. For the IC's control pin, use 20-gauge wire.

The relays are polarity insensitive with the exception of the two time-delay relays. Mount the circuit board to the two chassis plates using 1″ standoffs. The controls and rotary switches are affixed with brass setscrew couplings, then attached to nylon rods. Nylon shoulder washers are used as bearings and support for the rods (*Photos 3* and *4*). The front panel is shown in *Photo 5*, while the back of the unit appears in *Photo 6*.

ADJUSTMENTS

After you finish and all voltages are normal, set the master volume control to the 12 o'clock position. With a signal generator (or test CD) set to 1kHz and using a DMM (or DVM) connected to the power-amp output jack, adjust trimmer resistor R4 so that both channels produce an equal voltage. Make the same adjustment to R32, except use a resistor instead of your headphones. It would be wise to allow a 48-hour burn-in period before making any final adjustments. ❖

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REFERENCES

1. Denzil G. Danner, "Tube Circuit Primer: A Reference," *GA*, 3/92, p. 24. Alan Kimmel, "The Mu Stage," *GA*, 2/93, p. 12. Alan Kimmel, "Letters," *GA*, 3/93, p. 40. Rickard Bergiund, "Distortion in Small Signal Triodes," *GA*, 6/95, pp. 16, 17.
2. Michael A. Burrows, "4-250A Beam Tetrode Power Amplifier," *GA*, 1/97.
3. Eric Barbour, "Uncle Eric's Dumpster," Vacuum Tube Valley, #6, p. 30.
4. Amperex Data Sheet, 9/59.
5. GE Essential Characteristics, 1973.

SOURCES

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Part Numbers (add PAT prefix)	4002	4004	4006	4008	4070-SSCR	2100-SSCR	4070-CFB	2100-CFB	2100-CFB/H	1070-UC	Unit
Nominal Power, RMS (note 1)	40	70	100	80 Triode	70	100	70	100	100	70	Watt
Primary Impedance (Raa)	5878	2756	1885	1239	4000	2000	4000	2000	2000	4000	ohm
Primary Current (IDC), maximum	117	225	326	359	258	387	258	387	315	387	mA
Sec. Load Impedance, nom. (Rls)	5	5	5	5	4	4	5	5	5	5	ohm
Turns Ratio (Np:Ns)	34.28:1	23.48:1	19.42:1	15.74:1	31.6:1	22.4:1	28.3:1	20.0:1	20.0:1	28.3:1	
Ultra Linear Tap	40	40	40	40	40	40	33	33	33	100	%
Cathode Feed-back Tap	-	-	-	-	-	-	7.1	10	10	100	%
Frequency Range, Flat (note 3)	24	63.7	96.5	104.5	84	102	67	84	131	110	kHz
Frequency Range, -1dB (note 3)	53.5	120.6	152.2	173	131	134	136	149	204	244	kHz
Frequency Range, -3dB (note 3)	98.8	187.4	217	251.5	185	177	222	224	290	451	kHz
Power Bandwidth Start, -3dB	25	22.7	20.7	20.5	14	14	14	14	23	14	Hz
Total Pri. Inductance (Lp) (note 2)	535	490	530	360	1163	675	1056	663	505	1574	H
Leakage Inductance, Pri to Sec (Lsp)	3.7	2.6	1.8	1.312	3.2	2.1	3.1	1.4	1.5	0.67	mH
Effective Primary Capacitance (Cip)	613	558	585	593	345	660	358	638	400	388	pF
Total Primary Resistance (Rip)	68.1	173.7	104	37.8	114	57	120	63	56	78.4	ohm
Total Secondary Resistance (Ris)	0.158	0.168	0.18	0.16	0.10	0.13	0.15	0.17	0.10	0.18	ohm
Insertion Loss (Ilos)	0.18	0.4	0.38	0.26	0.23	0.26	0.25	0.28	0.2	0.24	dB
Quality Factor (Lp/Lsp)	144,610	188,510	294,410	274,410	366,000	321000	338,000	474,000	337,000	2,440,000	
Freq. Decade Factor (FDF) (note 4)	5.07	5.67	5.85	5.96	5.7	5.47	6.03	5.96	5.95	6.7	
Case size, diameter x height	Black Polyamid 125.6 x 65.3				Spun Aluminum, with textured black finish 152.4 x 88.9						mm
Weight	2.4	2.4	2.6	2.6	5.43	6.18	5.62	6.21	4.42	5.53	kg
Price $US	$201	$205	$201	$185	$302	$271	$283	$247	$249	$260	$US
Price $CN	$251	$257	$251	$231	$378	$339	$354	$309	$311	$325	$CN

Notes: 1) Measured and calculated with balanced DC current and AC anode voltage in the circuit power tubes. 2) 240V 60Hz across primary winding.
3) Measured and calculated at 1mW in Rls; ri and Rls are resistive loads 4) FDF=log (fh3/fl3) = number of frequency decades transferred.

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Reader Service #5

Cathode-Driven Power Triodes

As a result of his work with transformer coupling, this inventive designer from down under uncovers a new triode drive topology that circumvents the problems generally associated with power triode schemes.

BY MARK KELLY

One popular way to increase the power available from a Class A triode output stage is to drive the grid positive, that is, into Class A2. There are several ways you can achieve this. Transformer-coupling from a low-impedance driver and direct-coupling from a cathode follower are the most popular, but direct-coupling from a choke-loaded driver stage or mu-follower stage is feasible. I believe significant problems with these schemes are caused by the large reduction in grid impedance that occurs in a triode at the onset of grid current.

One requirement of A2 design is to provide a low-resistance ground-return path for the grid current, since any resistance here will cause the grid bias to vary with the signal. In the case of transformer-coupling from a low-impedance driver stage, the resistance-to-ground problem is solved by making the DC resistance of the driver secondary as low as possible. The design of the grid-drive transformer is problematic, however, in that if you optimize it for the high-impedance Class A1 condition, it will not perform well in Class A2, and vice versa.

The Shishido IIT topology is an attempt to minimize this by ensuring that the output tube is in A2 most of the time, but this is best achieved with a low ratio of R_p to r_p, which means you must use feedback to keep the output impedance down. Direct-coupling from a cathode follower eliminates the problems with transformer design, but it is then more difficult to keep the resistance of the grid-current return path to a sufficiently low level.

ABOUT THE AUTHOR

Mark Kelly is the proprietor (chief cook and bottle washer) of a small startup company, Indigo Electronics, which produces a 211 balanced (push-pull) amplifier using the inverted cascode load drive. Mark spent his childhood making space cities out of spares in the shed and is mostly self-taught. Currently, he is the wine maker at Heathcote Winery in Victoria, Australia.

GROUNDING THE GRID

You can avoid these problems by tying the grid directly to ground and applying signal and bias at the cathode, effectively forming a grounded-grid output stage (*Figs. 1a* and *1b*). You can use positive or negative bias as required, but obviously in reverse polarity to grid bias. This circuit has the additional advantage of negating the Miller effect, and thus improving the HF response of the driver stage.

If you use the cathode of the output tube as the input terminal, the input impedance in the Class A1 condition is given by $Z_{in} = (R_p + r_p)/(\mu + 1)$. I can't find in any of the standard texts a formula for input impedance with grid current flowing, but with some thought, you can derive it. In Class A2, the cathode current is split between the anode and the grid. Calling the internal grid resistance r_g, analogous to r_p,[1] the input impedance will be the parallel sum of r_g and the input impedance that would apply if no grid current were flowing. Assuming appropriate values for r_p, this gives

$$Z_{in}A2 = \frac{r_g(R_p + r_p)/(\mu + 1)}{r_g + (R_p + r_p)/(\mu + 1)}$$

$$\text{or} \quad \frac{(R_p + r_p)}{(\mu + 1) + (R_p + r_p)/r}$$

Since r_g is the change in grid voltage required for a unit change in grid current, you can derive it quite simply by inspecting the tube's grid-current curves and interpolating.[2]

The grid- and plate-current curves for the Svetlana SV572-10 and 572-30 power tubes are given in *Figs. 2a* and *2b*. From these curves, for any given quiescent operating point and load, you can derive a curve that will show grid current versus grid voltage for those conditions. *Figures 3a* and *3b* give the curves for the SV572-10 and 572-30 with B+ of 960V, I_a of 105mA and R_p of 7.5kΩ. The slope of each of these lines is then the grid resistance r_g. *Figures 4a* and *4b* give r_g and the cathode input impedance as derived previously against grid voltage.[3]

The grid voltage is taken only to +40V, since this is the Class A2 limit for these operating conditions. (If pushed beyond this point, the stage would be in Class AB2.) The onset of grid current affects the cathode input impedance much less than that of the grid, and the change in the 572-30 input impedance is less than that of the 572-10, since the cathode input impedance in the A1 condition is

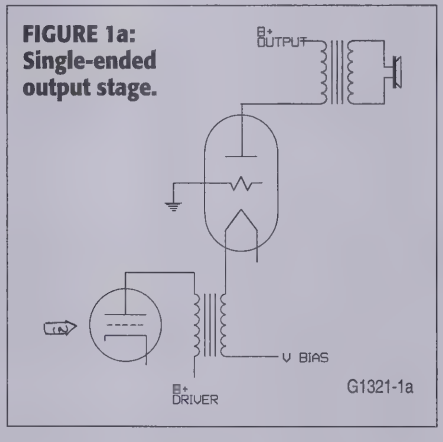

FIGURE 1a: Single-ended output stage.

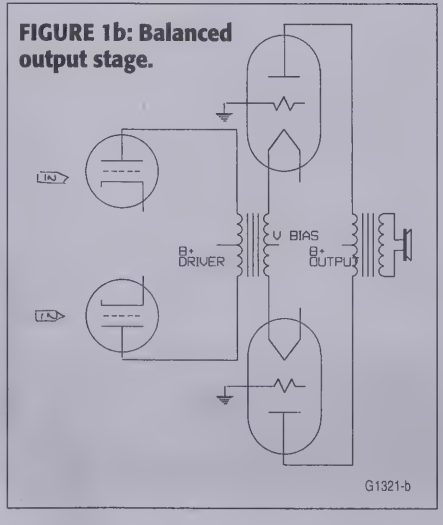

FIGURE 1b: Balanced output stage.

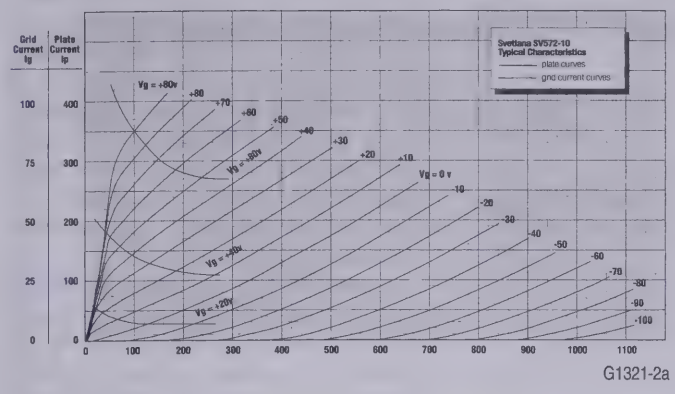

FIGURE 2a: Plate- and grid-current curves for SV572-10. (Reproduced with permission of Svetlana Electron Devices.)

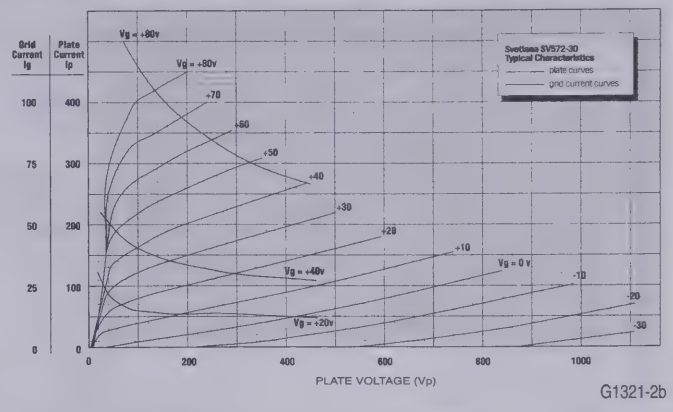

FIGURE 2b: Plate- and grid-current curves for SV572-30. (Reproduced with permission of Svetlana Electron Devices.)

lower, but the grid resistances for the two tubes are similar.

POWER AMPLIFIER

Because the cathode input impedance of the output stage is relatively low, the driver stage must be capable of driving current as well as voltage, and thus you will need to configure it as a power amplifier. The amount of power delivered will depend on the input impedance and the drive voltage required. In the case of the 572-30, the driver stage must swing about 30V RMS into a load with a minimal impedance of 280Ω, which corresponds to a power of 3.3W. For the 572-10, the driver stage needs to deliver 70V RMS into 450Ω, requiring 11W.

The driver power is the cathode swing times the cathode current, and the output power is the anode voltage swing times the anode current, so their ratio depends on the ratio of anode-to-cathode swing, which equals $\mu + 1$, as well as the ratio of anode-to-cathode current, which reduces from 1 in Class A1 to a lower value in A2, reaching about 0.5 at the A2 limit. The power sensitivity will therefore increase as the amplification factor of the output tube increases.

The theoretical limit of power sensitivity is reached when $R_p = 2r_p$, the reflected driver impedance is zero, and the decrease in input impedance at the onset of grid current is also zero. At this condition, the required driver power would be $2 \times P_{out}/3(\mu + 1)$. In all practical cases, the driver's power requirement is much higher than this—you can use $3 \times P_{out}/(\mu$

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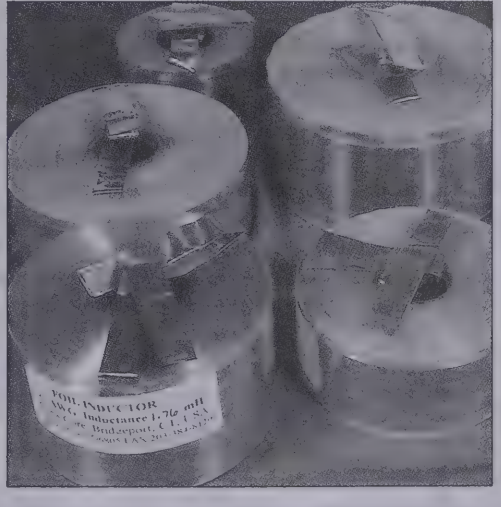

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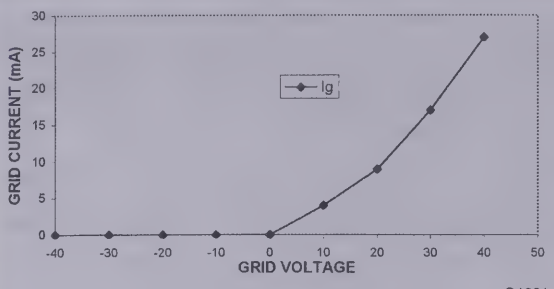

FIGURE 3a: SV572-10 grid current versus grid voltage, conditions as per text.

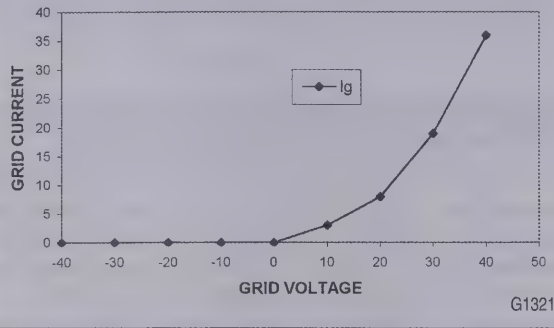

FIGURE 3b: SV572-30 grid current versus grid voltage, conditions as per text.

+ 1) as a reasonable rule of thumb.

One further advantage of this circuit is that the driver power flows through the output tube and is delivered to the load, slightly increasing the efficiency. But beware of any argument that hinges on increased efficiency—that's the kind of thinking that gave us the pentode and solid state.

TRANSFORMER COUPLING

The best way to transfer this power into the cathode circuit is by transformer coupling. The transformer you use will need to be wound to give an appropriate primary impedance with the cathode input impedance across the secondary, and will thus have a much lower turns ratio than a speaker output transformer. The design of this transformer is, however, basically the same as a power output transformer, and this means that the design is less problematic than an interstage transformer design.

In the case of the single-ended circuit, it makes sense to arrange the transformer so that the DC flux induced by the primary is the reverse of that induced by the secondary, so that the total DC flux is reduced. (With an appropriate turns ratio, you can theoretically reduce it to zero, but there are other factors that influence the choice of turns ratio—see further discussion below.) This has the secondary benefit that the driver and the output will be antiphase, thus allowing a degree of harmonic cancellation.

One drawback of the cathode-driven transformer-coupled output stage is that in directly heated triodes, the input signal swings the heater, leading potentially to crosstalk between channels, or signal degeneration between phases of balanced designs caused by leakage between heater supplies. There is also the potential for interaction between the heater supply and the driver stage.

In practice this has not raised its ugly head, but if it should, one solution is to use low DCR high-current chokes (such as those made by One Electron) in the heater supplies. These would act as a low-pass filter, since the interaction would probably be the result of capacitive coupling between windings at high frequencies.

Another drawback is that the reflected driver impedance in the cathode circuit provides negative-current feedback in the output tube, thereby increasing the effective output impedance of the power stage (the output impedance of a triode with cathode resistance is $r_p + [\mu + 1]r_k$). In this case, r_k is the reflected driver output impedance plus the DC resistance of the secondary.

Assuming the secondary DC resistance to be negligible, you need to minimize the effect of the output impedance of the driver stage. One way to do this is to take advantage of the design rule that the input impedance of the driven stage must be higher than the output impedance of the driving stage. If you call the ratio between them x, the increase in output impedance will be proportional to 1/x, so the larger the ratio x, the better.

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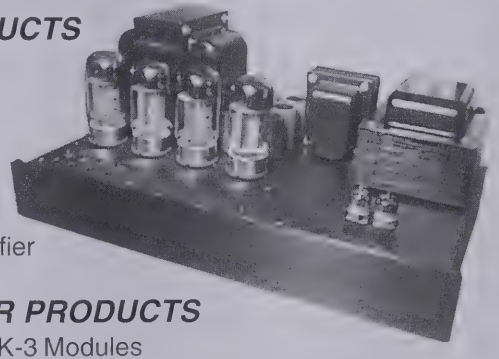

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Reader Service #96

TABLE 1

TECHNIQUE	POWER	LINEARITY	GAIN
Increased turns ratio of coupling transformer	decrease	increase	none
Cathode follower driver	none	increase	decrease
Shunt resistance across transformer primary	decrease	decrease	none
Negative voltage feedback	none	increase	decrease
Positive current feedback	none	decrease	increase

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ECC82	5.00	EL34 (TESLA)	8.00	6336A	46.00	B9A (Ch. or PCB) Gold Plated	3.00
ECC83	5.00	EL34 (Large Dia.)	8.50	6550A	11.00	Octal (Ch. or PCB)	1.80
ECC85	5.00	EL84/6BQ5	4.70	6550WA or WB	13.50	Octal (Ch. or PCB) Gold Plated	4.20
ECC88	5.00	EL509/519	13.00	7581A	11.00	4 Pin (For 2A3, 300B Etc.)	3.30
ECF82	5.00	E84L/7189A	6.50	807	9.00	4 Pin Jumbo (For 211 Etc.)	11.00
ECL82	5.00	KT66	9.50	811A	11.00	4 Pin Jumbo (For 211 Etc.) Gold Plated	15.00
ECL86	5.00	KT77	12.00	812A	34.00	5 Pin (For 807)	3.00
EF86	5.50	KT88 (Standard)	12.50	846	30.00	7 Pin (For 6C33C-B)	4.50
E80F Gold Pin	10.00	KT88 (Gold Special)	21.00	RECTIFIER TUBES		9 Pin (For EL. P/509, Ch. or PCB)	5.00
E81CC Gold Pin	6.80	KT88 (GLO)	30.00	EZ80	4.00	Screening Can (For ECC83 Etc.)	2.00
E82CC Gold Pin	8.00	KT90	24.00	EZ81	4.50	Anode Connector (For 807 Etc.)	1.50
E83CC Gold Pin	7.50	PL509/519	9.00	GZ32	11.00	Anode Connector (For EL 509 Etc.)	1.70
E88CC Gold Pin	8.00	2A3 (4 or 8 Pin)	14.50	GZ33	9.50	Retainer (For 6LWGC Etc.)	2.00
6EU7	6.00	211	22.00	GZ34	6.50		
6SL7GT	4.50	300B	50.00	GZ37	6.50		
6SN7GT	4.50	6C33C-B	27.00	5U4G	5.00		
6922	5.20	6L6GC	6.50	5V4GT	4.50		
7025	6.20	6L6WGC/5881	8.00	5Y3GT	4.00		
		6V6GT	5.00	5Z4GT	4.50		
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Reader Service #40

TRANSFORMER WINDING

There are several ways to increase x. One is to wind the coupling transformer so that the primary impedance is many times the anode resistance of the driver tube. This reduces the proportion of the tube's anode impedance that is reflected into the secondary, thereby also decreasing the output impedance. A second method is to use a low-impedance driver topology, such as a cathode follower, which will require a much higher drive voltage.

A third way is to place a shunt resistance across the primary of the coupling transformer, which shunts some of the driver power through the resistor and reduces the change in voltage caused by a change in load. This leaves less power to drive the output. A fourth is to apply a degree of negative-voltage feedback to the driver stage, and a fifth is to apply a degree of positive-current feedback.

The effects of these changes on the driver stage are summarized in *Table 1*. None of these techniques precludes any of the others, so you may use any combination. Note that you could use the increase in driver distortion produced by the positive-current feedback to improve the linearity of the output stage by distortion cancellation.

The most straightforward solution is to use a low-impedance power triode such as a 2A3 or a 300B as the driver tube, and to use a high turns ratio to give a high re-

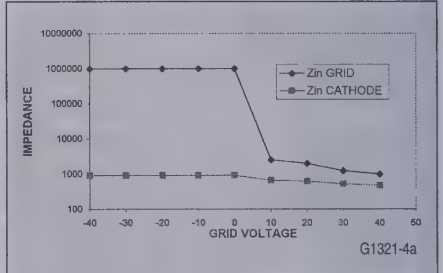


FIGURE 4a: SV572-10 grid input impedance and cathode input impedance versus grid voltage, conditions as per text.

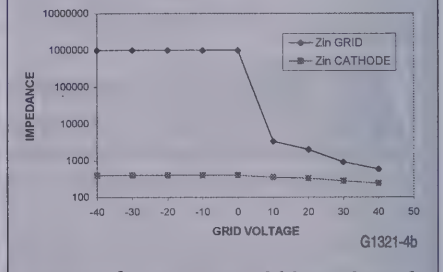
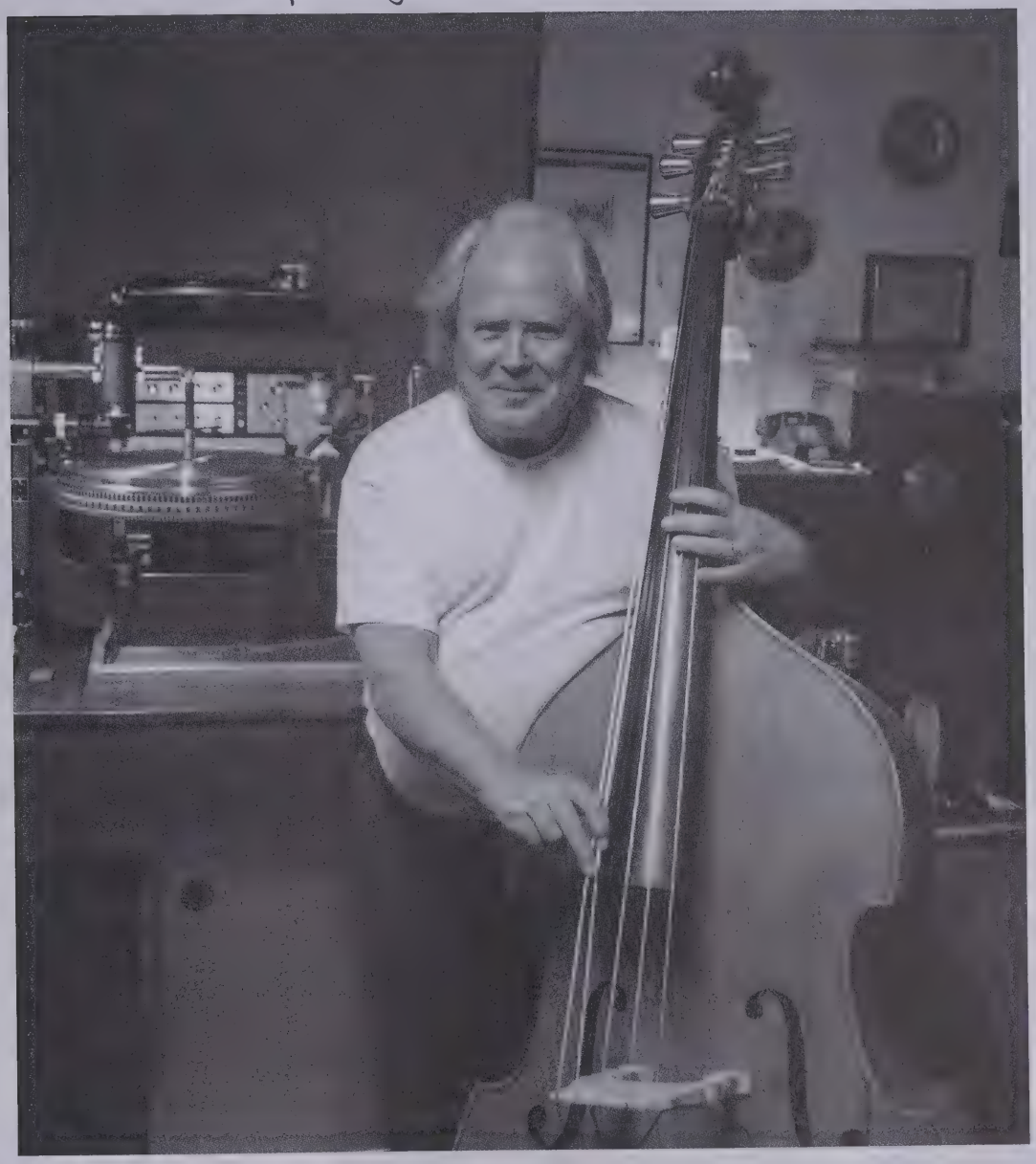


FIGURE 4b: SV572-30 grid input impedance and cathode input impedance versus grid voltage, conditions as per text.

Cardas Frequency Sweep and Burn-In Record



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flected load impedance on this tube. The power available from the driver tube will decrease slightly as the turns ratio increases, but a more serious effect is that the primary inductance required to give good LF response will increase directly with the impedance of the transformer. This will, however, still be less than that required by an equivalent interstage transformer.

HAPPY DRIVING

In the cases of the 572-30 and 572-10, the 2A3 will drive the 572-30 happily, but you will need more power for the 572-10, so a 300B is a good (if expensive) choice. For the 572-30/2A3, a cathode drive transformer turns ratio of 3.5:1 will give a reflected impedance of 4k in Class A1, falling to 3.5k at the A2 limit. The effective r_k will be $800/(3.5)^2$, or 65Ω, which will raise the effective plate resistance by $(30.5 \times 65) = 2k$, taking it from 4.6k to 6.6k. This will give a damping factor of about 1.1 into the 7.5k load.

With the 572-10/300B, a turns ratio of 3:1 gives a reflected impedance of 6k in Class A1, falling to 4k at the A2 limit. The effective r_k will be $700/3^2$, or 78Ω, which will raise the effective plate impedance by $(10.5 \times 78) = 850\Omega$, taking it from 2.1k to 2.9k and giving a damping factor just over 2.5 into the 7.5k load.

A damping factor of 2.5 is about ideal unless you're hopelessly mired in the "more is better" thinking of the mainstream transistor manufacturers, but the damping factor of the 572-30 is a hopeless case. You could raise the load impedance, but this would reduce the available output power. You could use some feedback, but the presence of two transformers in the signal path makes the application of feedback very difficult. To alleviate this problem, you could use cathode-coupled feedback from the output-transformer secondary to the driver-transformer secondary, but this reduces the gain of the output stage, so you may as well use a lower-mu tube to start with.

You can see that there are trade-offs between the power required from the driver stage, the degree of impedance drop at grid-current onset, and the output impedance. These trade-offs are governed by the ratio between the mu and output impedance of the tube, that is to say, its transconductance. Mr. Svetlana, what I wish for Christmas is an SV572-20, with a g_m of 6.5mS, an r_p of 3k, and a mu of 19.5. ❖

NOTES

1. The shapes of the anode current curves show that the presence of grid current at positive values of E_g changes the resistance of the electron flow to the plate, this effect being induced by the division of space current between the plate and the grid. These changes are in a direction opposite to the reduction in r_p due to increased plate current (following Child's Law), and are in any case swamped by the effect of the load resistance. If you need to calculate them, you may do so by taking a tangent to each plate curve at the point where the loadline crosses it, and applying these values of r_p in the formulas.

2. For accurate interpolation, use the relationships

$I_g/I_p = k\sqrt{(E_g/E_p)}$ where $E_p > E_g$, and $I_g/I_p = k(E_g/E_p)^2$ where $E_p < E_g$.

($k = I_g/I_p$ when $E_p = E_g$)

There exists no simple method of deriving I_g—and thus r_g—from electrode voltages by algebraic analysis, but see Charles Rydel's Spotlight article in *V&T News* (3/98, p. 17) for an empirically derived model using SPICE.

3. The input impedance to the grid with $I_g < 0$ has been chosen as 1M for demonstration purposes. The actual value in practice will be higher than this, but will depend on factors such as the gassiness of the tube, the presence or absence of grid leak resistors, the leakage reactances of the interstage transformer, if present, and so on.

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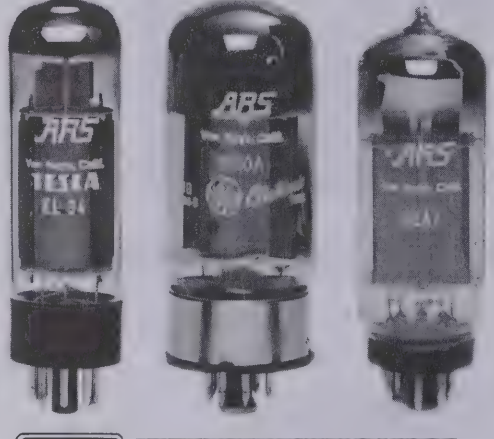

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300B CHINA	78.00	156.00	
807 RCA USA	25.00	50.00	100.00
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Reader Service #75

Trolling the Scrapyards

"One man's junk is another man's treasure" was never more applicable than in the world of electronics. With a discerning eye and persistence, you could uncover some valuable audio gear.

BY T.D. YEAGO

When I proposed to write a few words on this subject, publisher Ed Dell managed to restrain his enthusiasm: "I guess there is a junkyard methodology," he wrote back, "...But I think a couple of pages (1,500 words) on pointers about the wonders of goods discarded by a technologically illiterate population would be entertaining."

Well, up to a point. Mr. Dell, like the vast majority of readers (I suspect), is familiar with the yardsale and thrift/junk-shop venues for plucking old gear from the post-consumer wastestream. But he seems to confuse scrapyards with dumps and landfills. Nope; they are very different animals.

Scrapyards are historically metal recyclers, fed almost exclusively by industrial and business sources that sell their scrap to the yard, which does some sorting, breaking, brokering, and then resells. The flow through a scrapyard is very different from the normal wastestream. Look around at the local economy and then look at the yard's flow, and you'll see that the second reflects the first.

The scrap from heavy industry and manufacturing never fails to impress me, but in among the mounds of re-bar, boilers, engine blocks, and truly big iron, you'll find pockets of very interesting gear. I've seen a lot of test gear, VARIAC-type autotransformers, equipment racks and chassis. Much of it I've never seen or heard of, but let me tell you, industrial gear is manifestly top drawer. I've learned a lot about building quality by poking around inside these battered units; there's no skimping, no cutting corners, no building to a price point.

Tube gear has slowed to a trickle since about 1990, but the stuff that does appear is primo—it had to be to last this long. The early '80s was the time to cruise the yards for tube gear, but I still recommend that you check out the scrapyards. It isn't always productive, strictly speaking, but if you're curious and poke around, you're going to find something interesting or instructive every time.

SCRAPYARD ETIQUETTE

The first thing you do is be a nice guy and play by the rules. Go into the office and ask if you can snoop around. They'll probably give you a hard hat and tell you to stay away from areas where heavy equipment is operating. Be as cooperative as you can possibly be. If you're wearing work clothes and heavy shoes, they might not think you're a complete rookie. Ask what scrap sells for. Around here, ferrous scrap goes for about $.15 a lb.

If you can strike up a friendship with the owner, by all means do so. I worked for a couple of years on the same Chamber of Commerce committee with the local owner. We're on pretty good terms, so she's confident I'm not an idiot or thief. I'm welcome to walk through the yard on Sunday, when no one's working. I'm welcome to any tubes or electronic parts I find, free. As far as they're concerned, these things are contaminants, and they're glad to be rid of them.

In turn, I do my bit by pulling PC boards out of gear and tossing them into the appropriate dumpster, and doing any other sorting I can to help out. If I find something that has scrap value, I put it aside in the weeds and come back during the week and pay for it. I just bought a nice, big, power-supply rack-mount chassis. I stripped out the transformers and parts I didn't need, so the bill came to $3.

I've found all kinds of great hardware, Teflon-insulated hook-up wire, and big film caps from the yard. Before they wasted away, I used to see a lot of big industrial printers from a local plant, each with big power supplies. And, try as I might to educate them, the owners of the yard were convinced that all electrolytic caps had PCB in them. So I was welcome to any and all, and I consequently have dozens of big Sprague DX-series caps, some of which will populate that chassis for a wretched-excess amp I've had on the drawing boards a couple years now. Watch this space.

CRUISING A YARD

Dress sensibly and bring your own tools. As you walk about you'll eventually figure out how (or if) the yard is organized. Bigger yards tend to be better organized, having a dedicated household-appliance section, for example. With smaller yards, organization is less specific. General categories might be cast iron, steel, sheet steel, stainless, aluminum and other alloys, and cuprous metals. Your yard may vary considerably.

Don't decide to climb a pile of scrap; you'll make the owners very nervous about their liability, and render yourself unwelcome.

Do take your time. Some of my most memorable finds have come when I was aimlessly staring at a mound of scrap and realized, "Hey, wait a minute, that looks like a chassis...." If you visit the yard regularly, you'll get a feel for where things are and what's new, so your trips become more productive. But even so, random poking around has produced some amazing results.

Try to visit regularly—for all the reasons above, but also so you'll get to know

the people, and they'll remember you and what you're interested in. They might see something you missed. Also, frequent visits build experience, and you'll gain an instinct for where to snoop around for things, as well as the ability to recognize valuable scrap. It's also fun and interesting if you have a hardware-oriented streak in your personality.

When you start frequenting a scrapyard, all that hardware can be a little overwhelming. Get a grip. Gather things that you have a realistic chance of actually using; I mean, what use will you ever have for *four* 30A powerstat autotransformers? Sure, you can trade some of this stuff, or even give it away, and you can always use staples such as terminal strips and high-quality nuts and bolts, but eventually you must reconcile your ambitions with your storage space or other limitations. Yes, scrapyard finds can be irresistible, and in more than one case a find has set me thinking along lines that resulted in a project, but I repeat: get a grip. Exercise a little restraint.

Be a nice guy. I can't stress this too much. You need to be completely cooperative if you wish to stand out and become welcome. The scrap industry is one of the last bastions of small, individually owned business. And these people can be extraordinarily idiosyncratic. Keep this in mind, and you'll do fine. ❖

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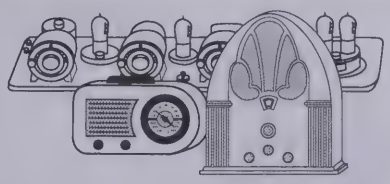

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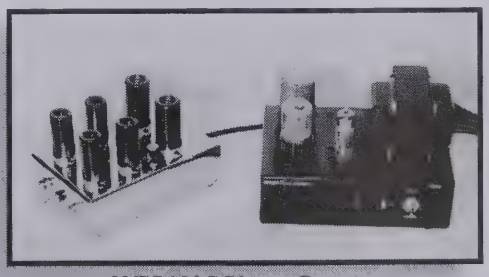

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Reader Service #95

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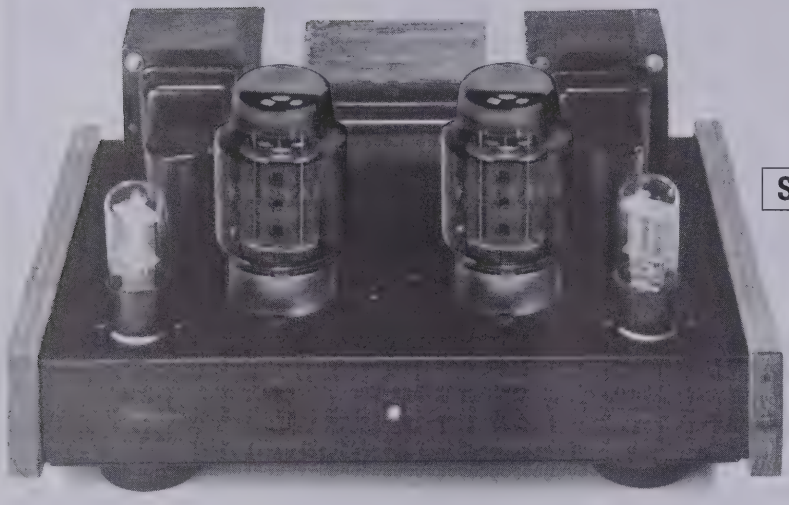

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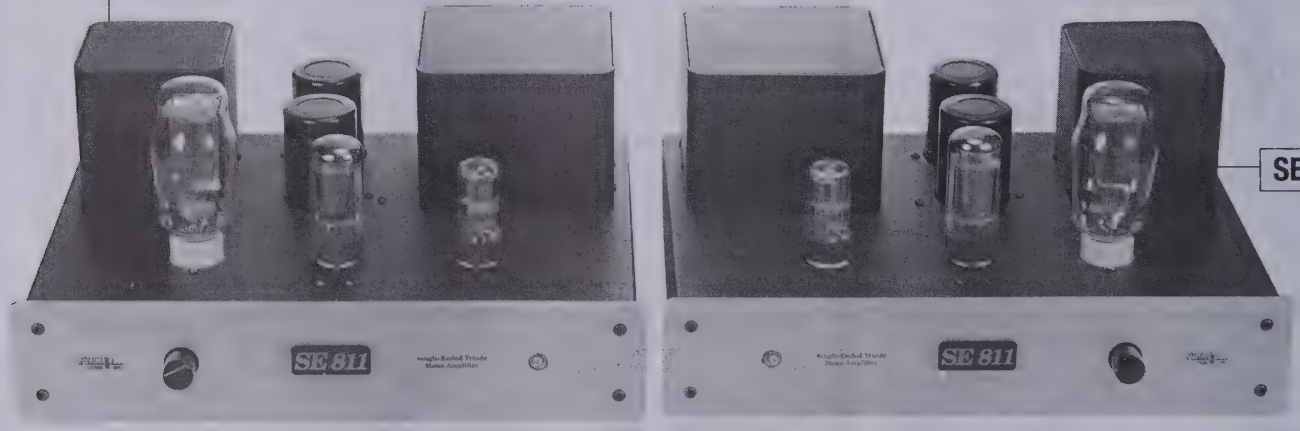

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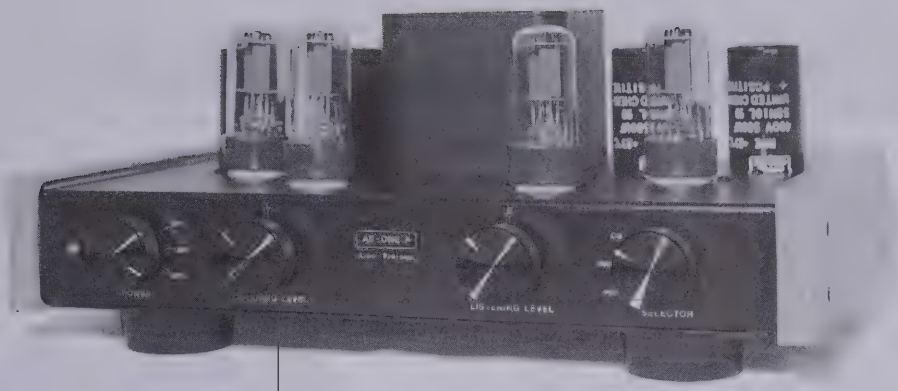

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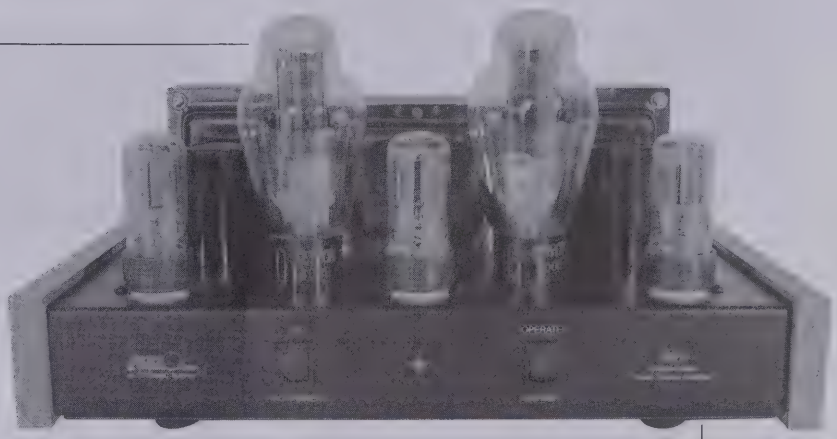

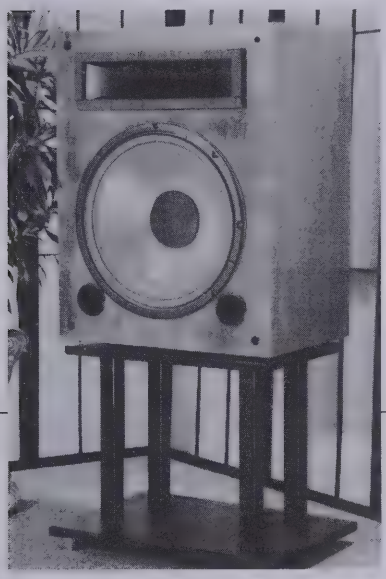

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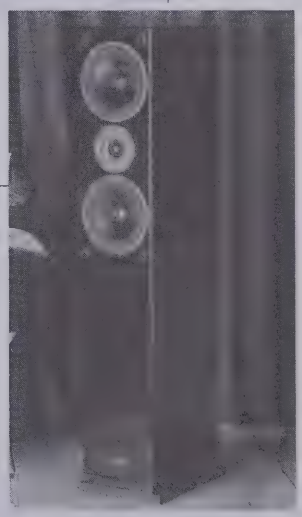

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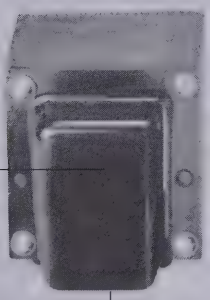

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Reader Service #1

I Built an Amp; You Can, Too

If you need a little encouragement to get started, take your cue from this first-time builder, who successfully completed an all-tube, stereo integrated amplifier.

BY STEVE ROBERTSON

PHOTO 1: The restored amp with the salvaged unit (inset).

Are you thinking about building from scratch, but don't know where to start? What if you begin a project and run into problems? Do you just need a little encouragement and maybe a few new ideas to get you moving? These were my questions a few short weeks ago. Since then, I found the answers and built an all-tube, stereo integrated amp as my first project from scratch. I wrote this article to help you find the answers, too.

I don't work in the electronics field, nor do I regard myself as an audiophile. I don't own an oscilloscope or any test equipment fancier than a cheap multimeter. I don't know much theory beyond what I learned in becoming an amateur radio operator as a teen in the '70s. However, I did learn a few things about tubes, built several Heathkits, and began to collect and repair old tube radios. Then I realized that those old AM tube consoles sound better than my modest, but not cheap, solid-state (SS) stereo gear. Tubes sound alive! I was determined to possess a tube amp, and I wished to build it myself.

I will lead you through my project from conception to completion. I know you may not be interested in building exactly the same unit I did, but I think the steps I followed apply to scratch-building virtually any electronic project. Along the way, I'll try to give you some guidance on how to find your own solutions to problems that may occur.

Define Your Objectives

I recommend that you go through an exercise to define project objectives. My main objective, of course, was to end up with a tube amp to replace one of my SS stereos. I also wished to get my hands dirty, which meant I had three options to choose from: restoring an old amp, building a kit, or building from scratch.

I already knew how to resurrect old tube radios by replacing bad capacitors and resistors. Rebuilding an old amp is not much different and seemed a little too mundane. I used to enjoy building kits, so that choice appealed to me. However, both the price and limited variety of current kits discouraged me. Once I realized how simple tube amplifiers could be, I decided that building from scratch was the way to go.

I needed an amp to drive my 15Ω, maximum 8Ω, two-way bookshelf speakers. I sought a design that required relatively few parts and used only tubes, including the power supply. Although I have a good junk box and supply of old tubes, I preferred a circuit that I could build with tubes and parts still in production. I also decided that a push-pull (PP) design offered the best chance for a good-sounding first project.

ABOUT THE AUTHOR

Steve Robertson is a computer-systems analyst. He works for Science Applications International Corporation, a large employee-owned technology consulting firm. He holds a Bachelor of Science degree in Management from Tusculum College. He also collects antique radios and is a private pilot. His amateur radio call sign is KE4OH. He is married and lives in Knoxville, Tennessee.

TABLE 1
INTERNET RESOURCES

http://duncanamps.simplenet.com
http://www.engr.uark.edu/~lar/firearnps.html
http://www.infomaniak.ch/~bonavolt/index.html
http://www.avvt.com/machmat/tubes/schem/htm
http://www.triodeel.com
http://www.ccinet.com/~phineasgage
http://whoville.uscd.edu/~stark/audio/DIYaudio.html

Circuit and Parts Selection

Where do you find circuits? New tube audio books and reprints of old ones abound now. You can find them in your public library, parts-supply houses, and even music-supply shops if guitar amps are your main interest. However, my favorite resource is the internet, where good circuits and advice are easy to find. See *Table 1* for a list of sites where you can begin your quest for circuits.

You might also want to read the rec. audio.tubes and other tube-related internet newsgroups. There you can ask questions and receive answers from knowledgeable tube enthusiasts. I find it to be a great source of motivation and problem-solving help.

Where are the parts? Since you're reading this magazine anyway, read on to find the ads of good parts suppliers. And don't overlook local electronics parts-supply houses. Even in my small city, I found a great source for good high-voltage caps, metal-film resistors, and assorted hardware.

I think you should conduct the search for circuits and parts simultaneously, because parts availability and cost considerations may lead you to change your mind about which circuit to build. I certainly changed mine.

I needed about 15Ω of output with tubes currently in production. PP 6V6s or EL84s became obvious best choices. I already knew a bit about the 6V6 from my old ham-radio gear. I chose to copy a 6V6 design used in a Pilot amplifier schematic that I found on a web site. I decided to build a pair of mono-block power amps, using breadboard construction since I thought it likely I would make many changes while I built and learned.

I made out my parts list to order the sockets, tubes, and transformers that I couldn't get locally. Then, on the very day I was going to place the order, I found one more source for parts and a reason to abandon my original plan—I bumbled into the Goodwill store.

I routinely check Goodwill and every other thrift store I pass for old tube radios. Imagine my surprise when I found an intact but broken tube amp (*Photo 1*) for $15. I grabbed it and ran home. It was a '60's vintage, PP EL84 stereo integrated amp of dubious manufacture and quality.

The metal cabinet was in good shape, the output transformers looked beefy, and the power transformer checked out okay. At some point, an output tube had overheated and cracked. It then obviously went into storage and became a mouse condo (*Photo 2*). A chassis, all the iron, and an enclosure for pennies per pound was enough for me to pick a Dynaco EL84 design and change my parts order.

Post Dumpster-Diving Stress Syndrome

An act of equipment salvage such as I had perpetrated is affectionately known as "dumpster diving." Just in case you decide to try it yourself, I don't wish you to agonize over what is worth saving and what is not. Over time, I learned these lessons the hard way.

Certainly worth saving are power and audio transformers, tubes, pilot lamps, toggle switches, long runs of hookup and shielded wire, knobs, screws, nuts, washers, and tube shields. Also worth saving, depending on their condition and your audiophile tendencies, are audio jacks, binding posts, chassis, enclosures, and terminal strips. *Never* worth saving are potentiometers, resistors, capacitors, rotary and slide switches, and tube sockets. No matter how good they look or what brand they are, life is just too short to fool around with this stuff.

Bear in mind that some of the parts you save, particularly transformers and tubes, may turn out to be bad. Also, don't be stymied by parts that are riveted to the chassis. Soft rivets, often dull in color, are easily drilled out. Hard rivets, usually shiny and often loose, you can punch out with a hammer and a small nail. *Photo 3* shows what was left of my chassis after I stripped off unwanted parts.

Construction Methodology

Tube-audio construction lends itself to the same methodology used to build that Cadillac in Johnny Cash's old song—that is, one piece at a time. Building and testing one portion at a time gives you two great advantages. First, if a problem arises, it is nearly always found in the section just completed. Second, successful completion of a small portion provides a lot of motivation to press on.

I decided first to build and test the power supply. This went quite well and did not take much time. Because my parts bonanza provided a single large power transformer, I had to build only one supply for both channels of the amp.

I wish to give you a few words of advice and caution at this point. First, remember that lethal voltages and currents are present in tube power supplies, so be careful. Second, don't forget to discharge the filter caps after turning the power supply off. A good way to do this is to insert a 10k or 20k 5Ω resistor between B+ and ground with the use of insulated alligator clips. Third, with no amplifier circuit to load the power supply, voltages will measure quite a bit higher than you expect during initial tests.

After the power supply, I built one

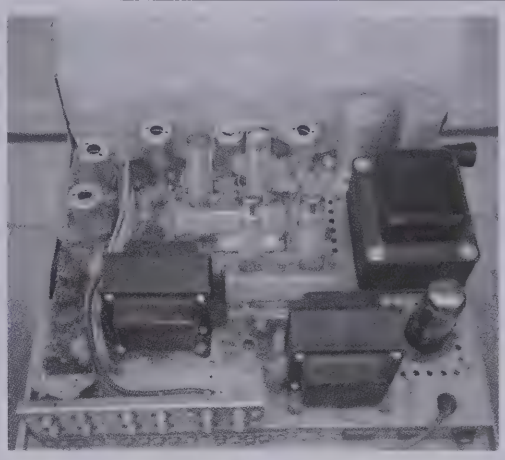


PHOTO 2: Junk-amplifier interior, showing mouse damage.

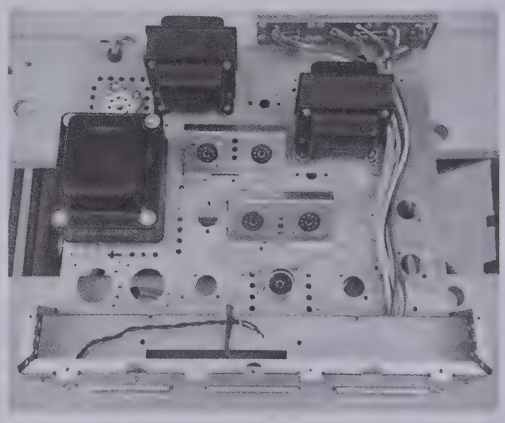


PHOTO 3: Chassis top after cleaning and stripping.

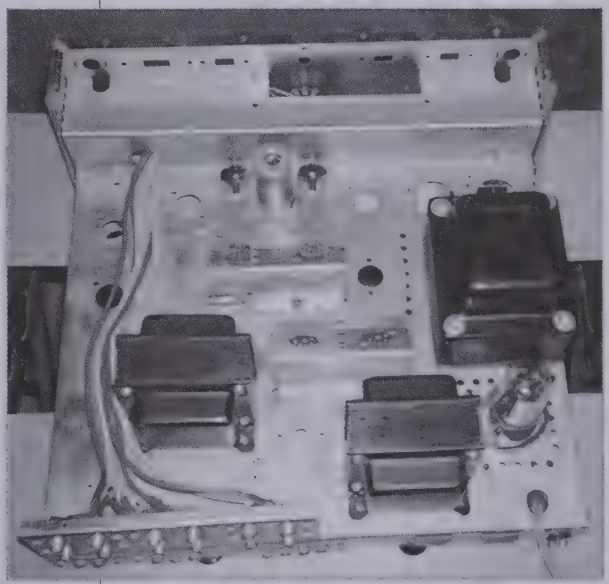


PHOTO 4: Chassis top with first channel operational.

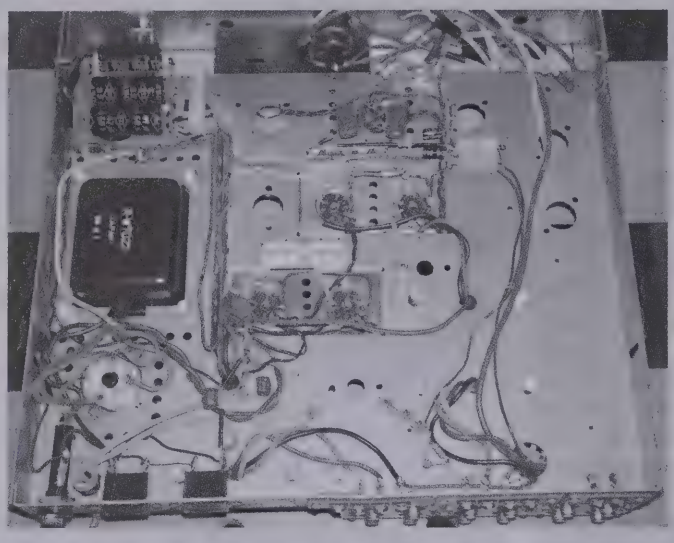
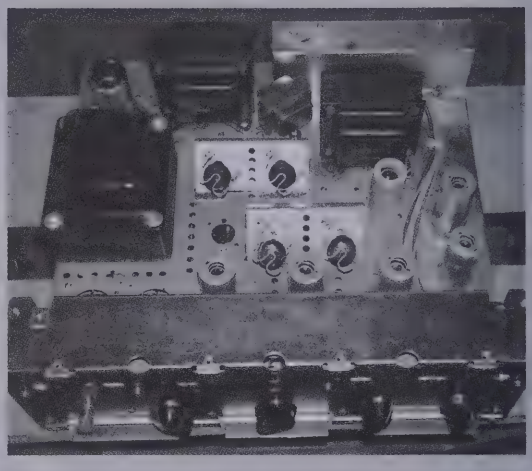


PHOTO 5: Chassis bottom with first channel operational.

PHOTO 6: Chassis top with tone control and phono stage.



channel of the power amp (*Photos 4* and *5*) and hooked up a tuner that had a volume control for initial tests. With fingers crossed and on the lookout for sparks and smoke, I turned it on. It worked! Well, it sort of worked. Music poured forth, but so did a loud, low hum.

Problem-Solving 101

I reasoned that the hum was either a power-supply problem or a heater-to-cathode short in one of the tubes. I swapped tubes. I swapped filter capacitors. I looked for bad solder joints and shorts. It still sounded like a buzz saw.

Then, quite by accident I touched both the amp chassis and the tuner faceplate at the same time. The hum changed a bit. So I measured the AC voltage between the two units, and the hum stopped completely. Say, this must be one of those ground loops I've heard about! After some more looking, I found that I'd failed to connect the ground side of the audio-input jack to anything.

Now that I had a working amp, I built the second channel. When I tested it, I heard no humming. No sir; instead, I had an ear-piercing oscillation. After a quick round of tube swapping and circuit checking, I ran out of ideas.

I posted my problem on rec. audio. tubes. Within a day, I had several responses that led me to the solution. One chap pointed out that in the circuit I used, the feedback resistor was also the phase-splitter cathode resistor. This gave me the idea of monkeying with the resistor value.

I eventually found a value that worked without audible oscillation. The only problem was that it just didn't sound particularly good. I reasoned that maybe I still had an oscillation, but that it was now inaudible.

Now I was faced with the realization that I'd picked the wrong circuit to build. The original plans called for output transformers with ultralinear (UL) taps, but mine didn't have them. I'd thought I could get away with just hooking the output-tube screens to B+ through resistors. Obviously, I figured wrong. I was lucky with that first channel, but not the second. The type of phase splitter I used is, I believe, known as a long-tailed pair. Something about it just was not compatible with my transformers.

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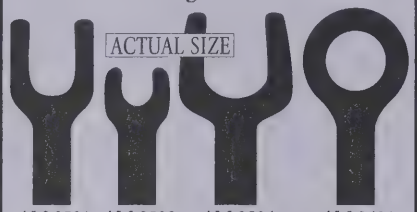

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Reader Service #21

Theory of Evolution

I went back to the internet and found an Eico and several Fisher EL84 schematics. They were similar and all used cathodyne phase splitters with non-UL transformers. Also, they all used different supply voltages from those I had, so I sort of improvised the component values that I would use.

I bought some new parts to rebuild the formerly screeching channel, and I must say, it ended up with a beautiful sound. The other channel received the same treatment, so then I had full stereo.

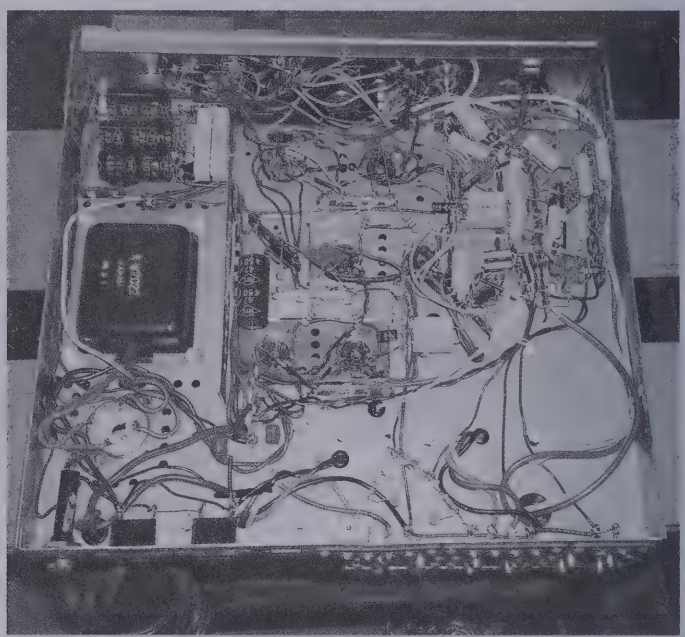

PHOTO 7: Chassis bottom with tone control and phono stage.

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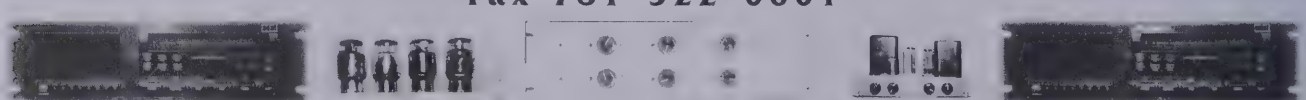

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Both sides sounded great and sounded the same.

At this point, I installed a volume control and a rotary switch to select the input source. All went well.

The next incarnation saw me add an RIAA phono preamp circuit that I found, of course, on the web. The phono stage was surprisingly quiet, but very weak in bass response.

My solution was to build a tone-control preamp. You can guess where I found the circuit. Since I now had one tube more than the power transformer originally fed, I added a small filament transformer to the now-crowded chassis (*Photos 6* and *7*).

The tone controls worked very well indeed, but I still didn't think the phono stage sounded right. I decided that, for now, I would use a commercial outboard phono preamp and build my own later. At this point I ripped out the phono circuit. I kept the tone controls, though (*Photos 8* and *9*).

I recommend that you plan for your project to evolve. Leave yourself some extra room on the chassis and in your budget to accommodate changes.

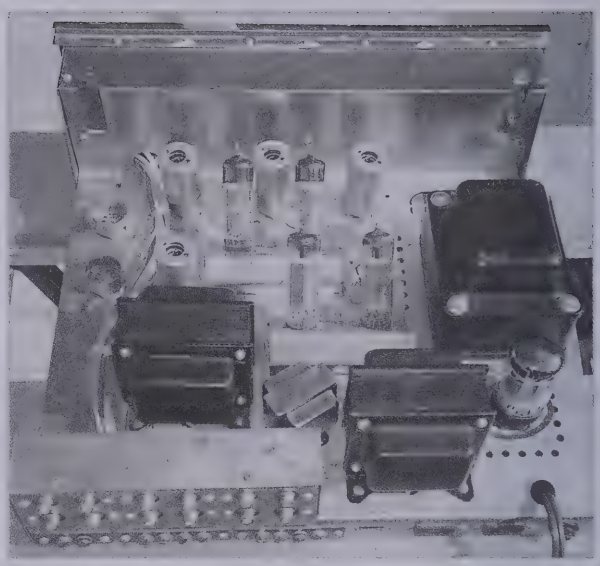

PHOTO 8: Chassis top complete after removal of phono stage.

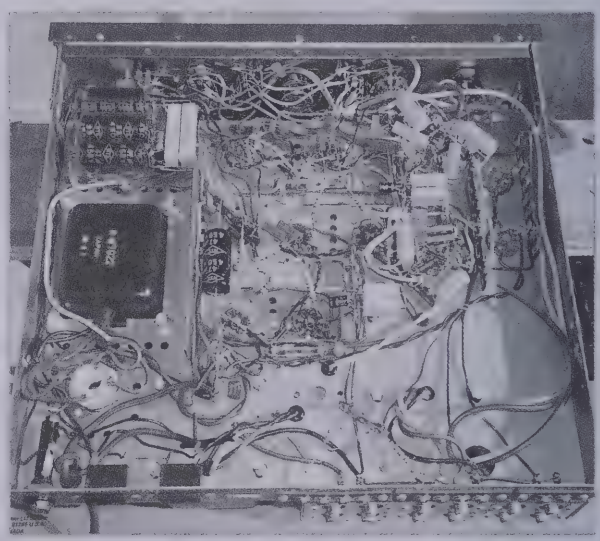

PHOTO 9: Chassis bottom complete after removal of phono stage.

Face Lift

When I found my junk amp, I conceived a way to reuse the chassis and enclosure. Everything was in pretty good shape, but the front panel was punched for many controls and switches that the new amp lacked.

My solution was simple, but I've never seen it anywhere before. All I did was cut a new front panel from aluminum sheet. A sheet of countertop laminate or very thin finished plywood should work just as well. I drilled holes for the controls, power switch, and pilot light. Then I spray-painted it and applied dry-transfer markings and letters. Finally, I simply glued it over the old panel with contact cement.

I broke the original plastic pilot-light lens that was press-fitted into the front panel. A trip to my local office-supply store netted a new lens—actually, a clear plastic ruler. From this I cut a new lens and used epoxy to hold it in place behind the original front panel. These rulers come in several nice colors. I chose purple.

The original metal enclosure cover had a brown wrinkled finish. Since that didn't appeal to me, I sprayed it with satin black paint, and I now have a new-looking black wrinkled finish (*Photo 10*).

If you decide to recycle an old enclosure, a little creativity goes a long way. My ideas may not work for your project, but if I can think up this stuff, so can you.

Problem-Solving 102

I was very proud of my finished project.

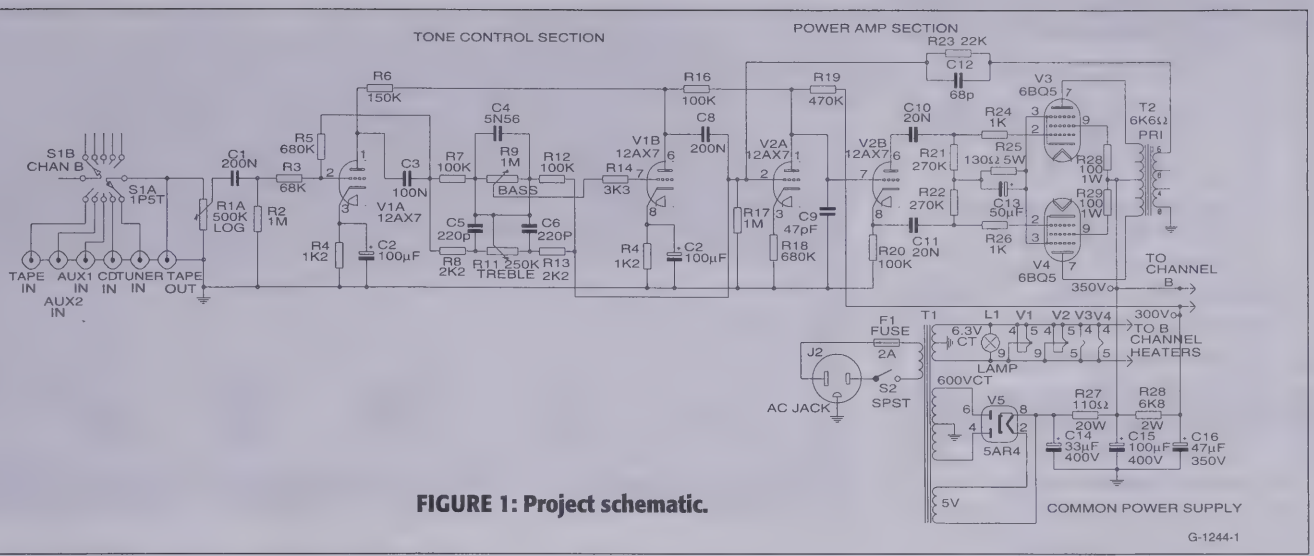

FIGURE 1: Project schematic.

TABLE 2
AMPLIFIER PARTS LIST

CAPACITORS	
C1, C8	0.2µF tubular
C2, C7	100µF electrolytic, 50V
C3	0.1µF tubular
C4	5560pF ceramic or mica
C5, C6	220pF ceramic or mica
C9	47pF ceramic or mica
C10, C11	0.02µF tubular
C12	68pF ceramic or mica
C13	50µF electrolytic, 50V
RESISTORS	
R1	500k audio taper
R2, R17	1M R3 68k
R4, R15	1.2k
R5	680k
R6	150k
R7, R12, R16, R20	100k
R8, R13	2.2k
R9	1M linear taper
R10, R14	3.3k
R11	250k linear taper
R18	680
R19	470k
R21, R22	270k
R23	22K
R24, R26	1k
R25	130, 5W, 10%
R28, R29	100, 1W
OTHER	
SW1	Rotary switch
T2	Output transformer, push-pull,6.6k primary, 15W
V1, V2	12AX7
V4, V5	EL84/6BQ5 (matched pair)
Power supply Section	
CAPACITORS	
C14	33µF electrolytic
C15	100µF electrolytic
C16	47µF electrolytic
Resistors	
R27	110, 20W, 10%
R30	6.8k, 2W
Other	
F1	2A slow-blow fuse
P1	6.3V pilot light
T1	Power transformer, 300-0-300V 200mA, 6.3V 6A, 5V 2A
V3	5AR4/GZ34

Notes: All resistors ½ W, 1% unless noted. All capacitors 450 working volts DC; 10%, unless noted.

My wife also liked the looks and sound, so I installed it in place of the retiring SS amp. Two days later, my listening pleasure was interrupted by the unmistakable crashing, buzzing sound of a tube arcing over.

Back on the bench with the cover off, the thing played fine. With the cover on, one of the output tubes would arc within a few minutes. I reasoned that the problem must be heat-related. I've seen resistors and caps in old radios become intermittent under load, which can change bias and cause tube overloads. I planned to replace the few parts that could be suspect, and the first part I grabbed had a bad solder joint to the tube grid. How embarrassing!

I played the amp for hours on the bench, and suddenly it arced over again.

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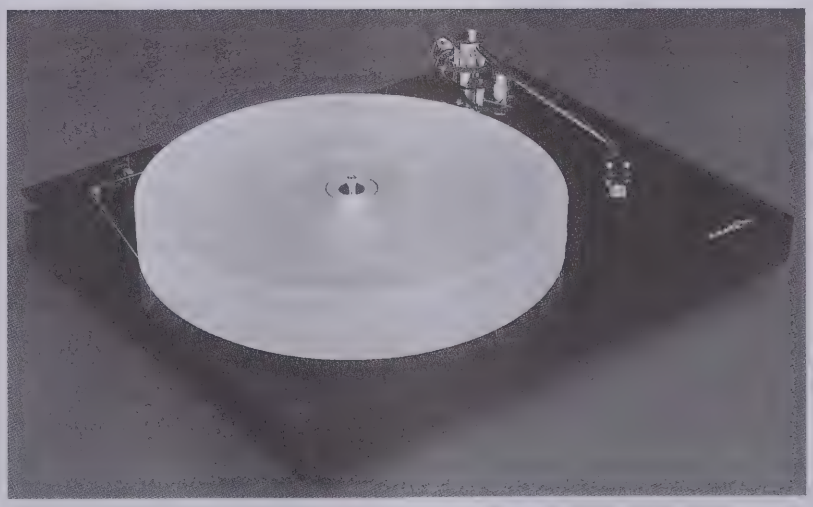

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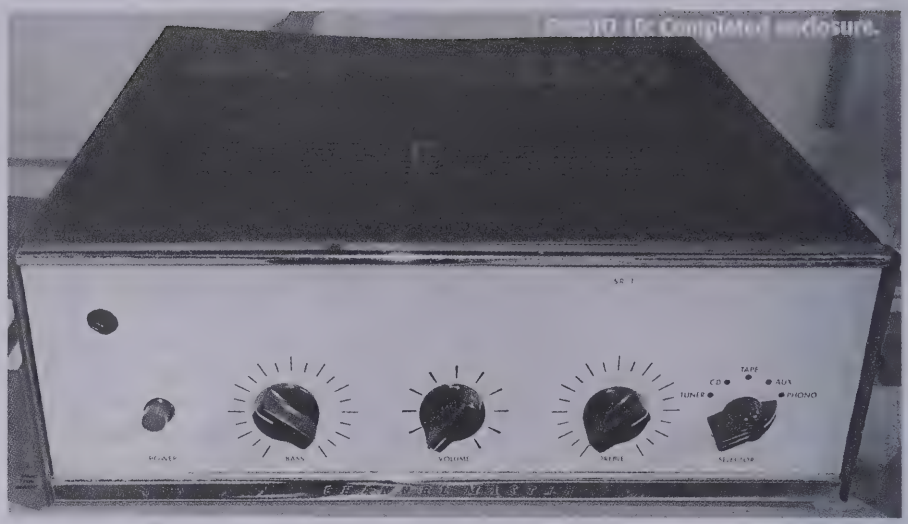

Only one possibility came to mind. Against my own advice, I recycled a few tube sockets, including the one containing the arcing tube. Some of us must learn the hard way. Some of us must learn it twice. I replaced the sockets with new ones.

Now it arced as soon as the B+ came up. I got some smoke this time, too, so I decided to replace parts again. And again, the first one I grabbed was the problem. Somewhere in the evolution of the project, I accidentally cut completely through a resistor lead. The cut was not visible and must have had pretty good contact until I started replacing the tube sockets.

Now everything worked fine. Well, fine for about two minutes. The tube that had been arcing suddenly developed a huge bright red spot on the plate. Thinking it must have died during the recent unpleasantness, I swapped tubes, but every tube I put into that socket overheated within minutes. Then I remembered the smoke from before. Something was toasted and I had to find it.

This time, I decided to use science instead of logic to find the problem. I started measuring voltages on each pin of the cool tube and the hot tube. The culprit appeared in about ten seconds: I found zero volts on the screen of the cool tube. That meant the other tube was doing much more work and overheating. The screen resistor for the cool tube was open, popped during one of the arcing incidents. I replaced it. The amp and I have been happy ever since.

I want you to avoid learning experiences like this. Do not reuse marginal parts. Also, after each session on the bench, grab every wire on the chassis with needle-nose pliers and shake every connection. I know that sounds like a bore, but the alternative is just a little too exciting.

Construction and Tube Notes

My amplifier evolved from portions of four other circuits. However, you should be able to duplicate my project quite easily, if you wish (*Fig. 1*). I changed values for some components based on what I could obtain locally. I probably do not have the optimal values for several

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parts, so don't be afraid to deviate from the component values shown.

My final circuit includes a tone-control amplifier. If you wish to leave that out, simply feed the audio signal from the wiper of volume-control R1 directly to the grid of V2A.

The 5Ω and 20Ω resistors were 10% wirewound ceramic units. Otherwise, I used 1% metal-film resistors. I used metalized polyester tubular capacitors for coupling, and ceramic discs for the small-value tone and bypass caps.

The junk amp I started with for this project had all of its original Japanese Channelmaster tubes. Naturally, I tried using them and some other tubes in the final product.

I settled on the Channelmaster 12AX7s. I know that Japanese tubes do not enjoy a good reputation, but I found them to be very quiet and not at all microphonic. I tried some Mullards, which sounded a little warmer. I also tried some US- and British-made RCAs. Neither sounded different from the Channelmaster tubes to me.

Since one of the original Channelmaster 6BQ5s was cracked, I had only one good pair. They sounded nice. I found out later, however, that they were not well-matched. In a dark room, I could see a softly glowing plate on one tube. I replaced them with a new matched pair of Sovtek EL84s, which also sounded very nice. The other pair I'm using are GE EL84s from another junk amp that I stumbled onto. They sound great, but are old and not quite as loud as the new Sovteks. I'm going to replace the GEs with Sovteks the next time I order tubes.

I'm using a current-manufacture Chinese 5AR4 rectifier. The relatively low current and voltage demands of this amp should help extend its life. The original Channelmaster GZ34/5AR4 seems to be beautifully made. I'm keeping it in reserve.

A 5U4 would be a possible current-production substitute in the power supply. Output voltages would be slightly lower, but these tubes are rugged, inexpensive, and readily available. My power transformer could not be trusted to supply the 3A needed for a 5U4 filament, or I would have used one myself. [The 5U4 heats in five seconds, which is six seconds faster than the filaments in the output tubes. The 5U4 is not a good replacement for the GZ34/5AR4. —Ed.]

You are welcome to contact me (through *Glass Audio* or e-mail at 72644.256@compuserve.com) to ask questions or make comments. As a reminder, I am not an electronics designer, so my ability to answer questions about theory and optimal component selection is limited.

Despite more than my share of trouble completing this project—much of it caused by my own mistakes—I still wish you to get moving and start your own. You can avoid most problems by careful circuit selection and shopping practices. If you do have a problem, you can find and eliminate the cause with a little thought and a lot of persistence. You will not be sorry unless you never try. ❖

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KIT REPORT

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Reviewed by Charles Hansen

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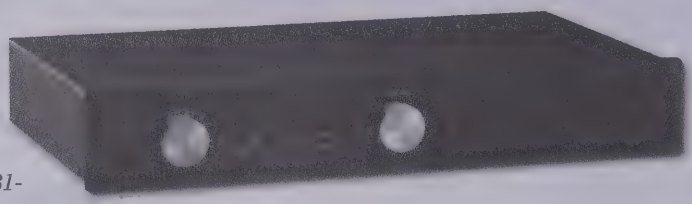

PHOTO 1: The "clamshell" package accommodates solid-state or vacuum-tube designs.

We have all run into the problem of putting a lot of time, effort, and expense into a home-built audio project, but can't finish the enclosure so that it looks as good as even the lowest-cost commercial product. Numerous articles were written in the electronic hobby press to help achieve a professional appearance on your home-built project.[1]

The first problem is the large number of cutouts needed for IEC power connectors, meters, cooling louvers, connector slots, rectangular switches, and the other holes that can't be drilled with readily-available drills and chassis punches. The second problem is the paint. Unless you buy a prepainted chassis, spray-paint cans just can't compete with an oven-baked or anodized finish. Third is the lettering. Good-looking enclosures are readily available, but that all-important front panel still ends up looking, well, homemade.

SPIRE TO THE RESCUE

Help is at hand. SpireAudio specializes in three types of great-looking custom aluminum enclosures for the DIY and small OEM community. The photos accompanying this article don't do justice to the real units—they are truly gorgeous!

The first is a 17″ × 10″ × 2.5″ black powder-coated machined aluminum preamplifier (*Photo 1*), which the company calls a "clamshell" package. It accommodates either solid-state designs or internal vacuum tubes mounted horizontally. The faceplate is a ¼″-thick black anodized piece of aluminum with beautiful understated light-gray laser-engraved lettering and nicely rounded corners. The panel is held to the chassis with four hex-key Allen screws set into counterbored holes.

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PHOTO 2: Another clamshell design that includes a natural-finish faceplate.

rugged. The top cover is held in place with three black anodized screws on each side and four on the rear. The cover securely overlaps the enclosure at all the mating surfaces, making an RFI-resistant joint. The black powder coating and anodized finish are absolutely flawless. The front panel has an input selector rotary switch, dual volume control, two mini-toggle switches for mute and tape monitor, and an LED power indicator.

Even more important, the rotary switch and the Alps volume control are mounted at the rear of the chassis, using SpireAudio shaft extension kits, which consist of long aluminum shafts with collars that pick up the standard control shafts for the components. Two set-

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screws on the collars connect the shafts together so they rotate as one, allowing you to place the input selector switch back near the input jacks where it belongs for minimum noise pickup. It also allows you to place PC-board-mounted controls and switches closest to their circuitry. The front of the chassis includes a nylon bushing to center the long shaft and prevent a loose fit.

The preamp's rear is outfitted with a rectangular rocker power switch, an IEC power receptacle, a fuse holder, and 12 input/output jack holes. If I were starting my Control Preamp[2] project today, I would definitely use this beautiful enclosure.

Cost for the basic black enclosure is $80. There are loads of à la carte options: the black powder coating adds $21, the anodized faceplate is $10, and the laser engraving is $35. The shaft extension kit for the two controls is $21 per pair.

The AC kit on the rear panel, with the rocker switch, IEC receptacle, and fuse holder mounted in place, is $12.50. If you want cooling slots in the cover, SpireAudio will punch them for $1 per inch. You can also purchase knobs, switches, LEDs, and other components from SpireAudio, or you can furnish them yourself. Volume discounts are available for OEM manufacturers.

The second chassis (*Photo 2*) is a 14″ × 10″ × 2″ plain aluminum clamshell box with a natural-finish aluminum faceplate. It has no engraving, but the front panel contains five control holes. Three were countersunk for the nylon shaft extension bushings. The rear panel is punched for 16 input/output jacks. The cost for the natural aluminum pre-amp enclosure is only $60. Rotor engraving is available for $35 (laser engraving is available only on the black anodized faceplates.)

The third chassis (*Photo 3*) is a 17″ × 12″ × 2.75″ black powder-coated six-sided box with a detachable bottom plate. It is designed for top-mounted vacuum-tube equipment. The satin-finish aluminum front panel has elegant rotor engraving in three fonts, including a script. The top of this enclosure is punched with vacuum-tube sockets and transformer mounting holes. The company will supply any custom pattern you want at a reasonable cost. Extra internal bracing is available for $5.

The front panel is equipped with a power indicator, two volume controls, and a mini-toggle input selector switch. The rear panel has the AC kit, holes for four input jacks, and six speaker-binding post holes.

All the enclosures are shipped with PVC-covered aluminum to prevent scratches on the outside surfaces as you machine the extra holes you need for PC-board spacers, transformers, connectors, switches, and so on. You can also contract SpireAudio to do this extra work to your own custom specification and drawing. According to the company, average machining adds only $20–30 per enclosure.

SpireAudio supplies other units, including enclosures in several sizes for solid-state and tube equipment, DAC devices, and specific designs, such as the Dynaco

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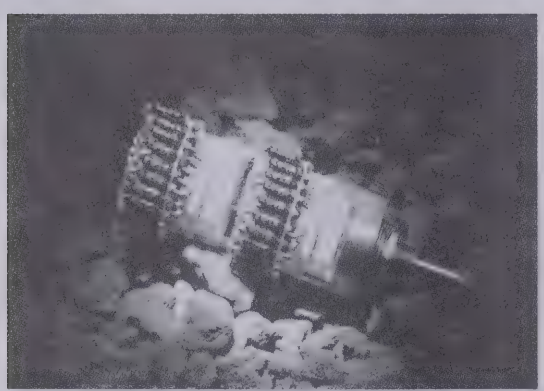

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Reader Service #86

REFERENCES

1. "Chassis Workmanship," *GA* "Letters," 1/97, pp. 57–60, 68; R. Spencer, "Showcase," *GA* 1/97, pp. 62–63; C. Wolf, "World Class Fit and Finish," *GA* 5/96, pp. 36–40, 69; S. Winthrow, "Custom Meter Faces," *Electronics Now*, April 1995, pp. 51–54; M. Rumreich, "Make Your Own Logos," *TAA* 2/94, pp. 29–30, 42; W. Schopp, "Build Your Own Custom Cases," *Popular Electronics*, April 1991, pp. 64–66, 91; T. Henry, "How to Make Your Projects Look Great," *Electronic Musician*, November 1990, pp. 19–26; K. Blair, "Pealing Paint Plight," *TAA* 4/88, p. 48; A. Newcomb, "Nameplate Magic-ScotchCal," *TAA* 2/84, pp. 41–42; P. Kelly, "Paint Your Chassis," *TAA* 5/84, p. 43.

2. C. Hansen, "Control Preamp with Headroom Module," *AE* 6/97, pp. 8-21.

PHOTO 3: This enclosure was designed for top-mounted tube equipment.

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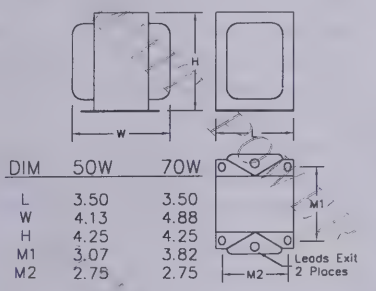
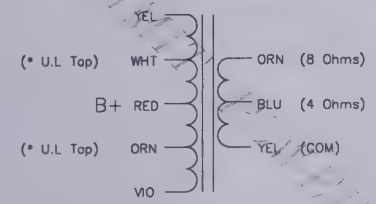


DIM	50W	70W
L	3.50	3.50
W	4.13	4.88
H	4.25	4.25
M1	3.07	3.82
M2	2.75	2.75



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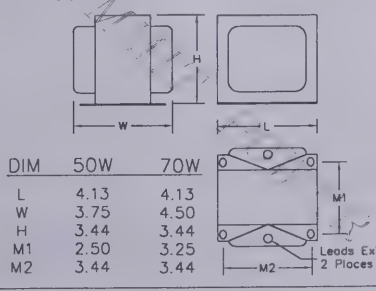

DIM	50W	70W
L	4.13	4.13
W	3.75	4.50
H	3.44	3.44
M1	2.50	3.25
M2	3.44	3.44

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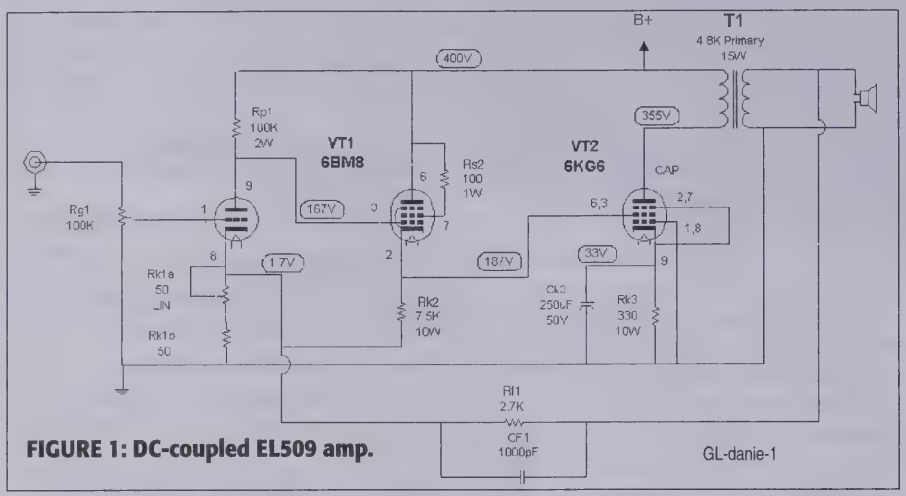

FIGURE 1: DC-coupled EL509 amp.

GROUND CORRECTION

In the EL509 schematic in my article ("Direct Coupling the EL509," *GA* 5/98, p. 48), I missed a connection between the EL509 grid and ground. The corrected schematc is shown in *Fig. 1*.

Those who always ground the speaker return will be OK. But not connecting the grid to ground will result in erratic behavior.

Bob Danielak
Bayville, NJ

SCHEMATIC UPDATE

Figure 1 on the 70W low-distortion triode amplifier (*GA* 5/98, p. 38) contains an error. It is corrected by connecting the junction of inverter resistors R9 and R10 to the B+ line at the junction of R20 and R8 (*Fig. 2*).

Joseph Norwood Still
Bel Air, MD

TRIODE/UL MODS

As a follow-up to my article in *GA* 2/98 ("40W Triode and 60W Ultralinear Amplifier," p. 1), the following modifications are required to ensure the amplifier has the proper operating plate voltage when the AC line voltage of 117V AC is exceeded. The modification permits the amplifier to operate with a 117, 120, and 123V AC line voltage and maintain the required 510V DC (no load) on the plates of the 6550s. This is done with the inclusion of 20 extra diodes and a SPDT (on-off-on) switch (*Fig. 3*).

NOTES

1. D9 through D40 (add 20 diodes to the original 30 diodes). This changes D40 to D60. Diodes are 2.5A, 1000V. Order from Parts Express at $.07 each.
2. If you added switch S2, as per original instructions for operating with line voltages below 114V AC, I suggest you remove this switch and add a new switch S2.
3. The new switch S2 is a SPDT (on-off-on) type, Radio Shack 275-654. Mount the new switch horizontally to avoid confusing it with the on/off switch S1. Use decals to label the switch 117V, 123V, and 120V. Set the on/off switch to off before changing the settings of S2.
4. Warning: lethal voltages are present in the 40W/60W amplifier. Exercise caution when working on the amplifier and do not

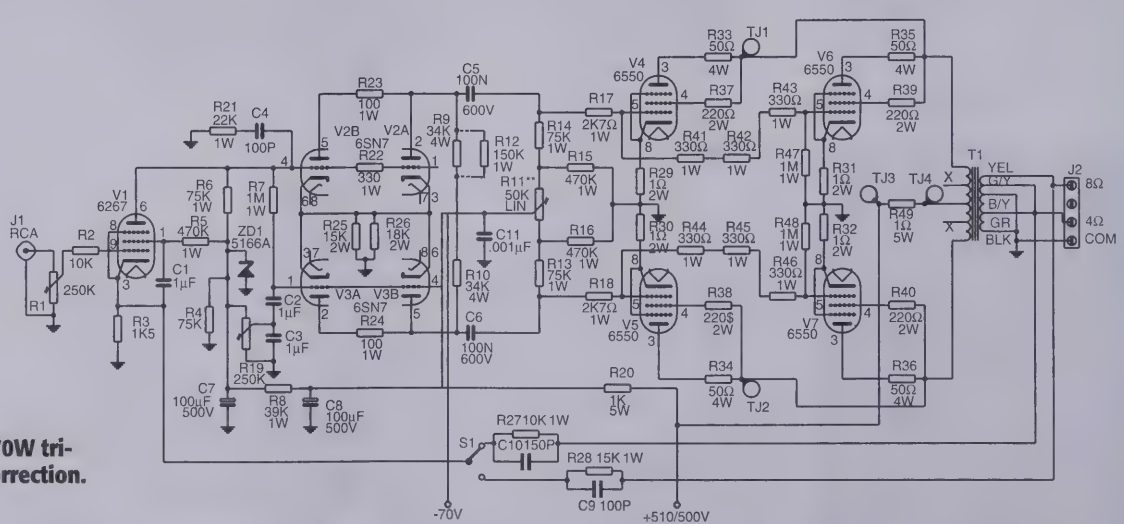

FIGURE 2: 70W triode amp correction.

**DUAL POT. PARALLELED 100K 1/2W, LINEAR
X = NO CONNECTION

G1248-1

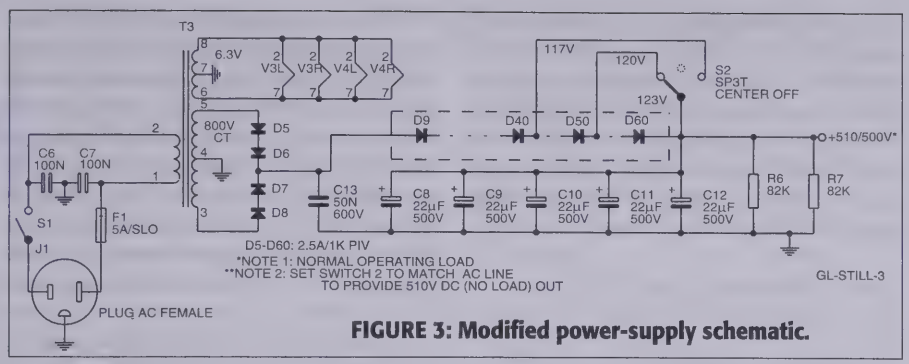

FIGURE 3: Modified power-supply schematic.

leave the amplifier in a turned-over position with children present.

Joseph Norwood Still
Bel Air, MD

MEASURING WHAT WE HEAR

I wish to commend Lynn Olson and Matt Kamna on "Sound of the Machine: The Hidden Harmonics Behind THD" (*GA* 4/97). While total harmonic distortion (THD) and intermodulation (IM) measurements are certainly revealing of amplifier performance, it is indeed spectrum analysis that provides the real insight. (I especially like their analogy to mass spectrometry on p. 8.) The Scientific Atlanta spectrum analyzer (SA) I use has a dynamic range of about 90dB, and there were always some solid-state amplifiers and preamps which did not register on the display. Some time ago I decided to connect the SA to the monitor output (the distortion-residual signal to the indicator meter) of my HP-339A distortion test set.

As with the Tek AA501A/HP3585A combination the authors used, once the HP339A notch filter removes the sine-wave fundamental, the distortion products are revealed with much more detail, down to the combined noise floor of the two instruments (about 112dB). The HP339A monitor output provides a 1V AC signal at the full-scale meter reading,

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independent of the measurement range. Thus, the noise floor is about 0.005%, or 50mV monitor signal output, on the lowest 0.01% full-scale THD range. Another option I would like to try is connecting the HP339A monitor output to an HP 3581A Wave Analyzer.

The concept of separate pairs of patterns for the odd and even harmonics never occurred to me, but when presented by the authors in terms of the IM sidebands they create, the potential relationship between harmonic falloff and audible difficulties becomes clear. *Stereophile* magazine has been making use of the new Miller Audio Research Amplifier Profiler to determine distortion under dynamic output conditions. Perhaps *GA* readers with sophisticated audio test equipment (Audio Precision System One, for example) will further explore this fascinating subject.

Charles Hansen
Tinton Falls, NJ

Lynn Olson responds:
I strongly encourage the use of the most insightful and powerful techniques to measure electronics, since we have found over the decades that conventional THD measurements have very little correlation with sonics. As I mentioned in a recent talk I gave at the VSAC98 (Vacuum State of the Art Conference), there are so many things wrong with loudspeakers, and so many things to measure...and some of those measurements actually have fair-to-middling correlation with subjective qualities.

It would be nice if we had a broad range of meaningful measurements for electronics as well. I wrote the *GA* 4/97 article to encourage people to look more insightfully at the underlying mechanisms of nonlinearity (odd versus even) and the implications for IM distortion, which is what we hear with real music.

The differential sensitivity of the ear for distortion versus frequency is important, which is why I focus on reducing distortion in the 1kHz–5kHz range most of all...this is also the part of the spectrum that is most important in designing loudspeakers.

The next step is to repeat the *GA* techniques for feedback amplifiers, and take careful note of how the distortion spectrum is changed as reactive loads use up the phase margin of the amplifier. I am guessing here, but I suspect that dynamic changes in distortion spectra with load, power, and PS variations are what we really hear, not the steady-state term.

Matt Kamna responds:
One of my future goals in the field of audio is to develop some test equipment to actually measure some of the sonic qualities of what we hear. It's an extremely difficult challenge that nobody has really addressed commercially yet. Several years ago at one of the Audio Engineering Society meetings, I briefly discussed this with Dr. Rich Cabot, the President of Audio Precision. At that time he did not seem to be very interested.

Audio design is not just a schematic on paper, but a very careful blend of good performance at the test bench and a judicious amount of listening. Recently at the VSAC we had a preamp tube and power output tube tasting. To my amazement, I was able to pick out the kind and brand of tubes I like to use to design my circuits! I am learning to trust my ears more and more.

Another example is AC vs DC filament supply on directly heated output tubes. Many people talk about which sounds better, but I've actually switched supplies with a toggle switch while auditioning my 300B amp. To my ears the sound is extremely close, although if you look on a spectrum analyzer there is a huge difference.

The old tired THD numbers just do not get the job done. If the "lower is better" game were true, we would all own and love those ultra-low distortion solid-state jobs. Why would anyone in his right mind even consider these high-distortion nonfeedback tube amplifiers? The time is ripe for new types of measurements and test equipment. Not necessarily expensive or even complex, just ones that make the right measurements!

For all you creative thinkers out there, maybe one way to make progress in this area of audio is to form a "think tank" team. Judging from one reader's response, I know there's interest in this subject. Would anyone out there like to try to better correlate what we hear with test-bench measurements? Let's move the industry forward, but this time in the right direction!

POWER VS THD

In "Optimizing the 2A3 Performance" (*GA* 3/97, p. 22), Mr. Jenkins has overlooked the fact that RCA rates the 2A3 at 15W maximum plate dissipation. While a number of tube manuals—some RCA manuals included—omit this vital spec, RC-15 by RCA does provide this parameter and its value.

In every one of the operating points of his Table 1, plate dissipation is greater than 15W! No wonder the author had a tube fail under these test conditions.

Charlie Rhodes
Upper Marlboro, MD

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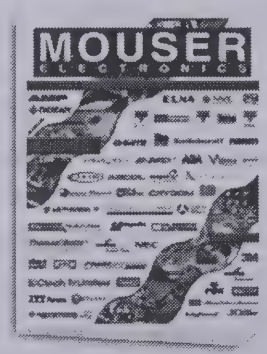

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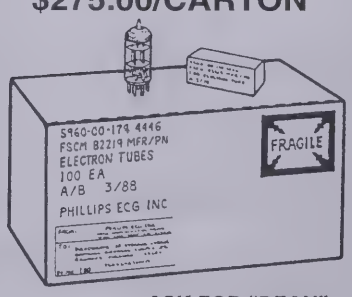

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Reader Service #98

Don Jenkins responds:
Mr. Rhodes has made a valid point in questioning the use of high plate current. As he mentions, the plate dissipation parameter is not listed in many reference sources. I would have selected the higher current anyway, since I was trying to illustrate how the various input and output parameters affect the total harmonic distortion (THD). The target was to find a set of operating values that would reduce the THD to less than 1%.

Table 1 shows how the 15W plate dissipation value limits the reduction of THD. Column 2 is for a 15W value and 2.55W to the load. For this set of inputs the THD is 2.6%—admittedly, from a listener standpoint, perhaps only detectable by those with golden ears.

The target power to the load in the original article was 2W. The data in *Table 1* shows how the THD changes with power. Using the 15W plate dissipation limit, a THD of less than 1%, at 2–3W to the load, appears unattainable.

TABLE 1
2A3 PERFORMANCE AT PV = 250, PLATE DISSIPATION = 15W

POWER TO 16Ω LOAD WATTS	THD%
1.76	1.98
1.99	2.14
2.16	2.26
2.77	2.63

The loss of the KEN-RAD 2A3 was due to an extreme overload of the plate current, greater than 200mA, and is obviously a condition to be avoided, and was due to a grid control error in the software. Since the original tests were done in April 1996, these same 2A3s have been used in many tests and are still working.

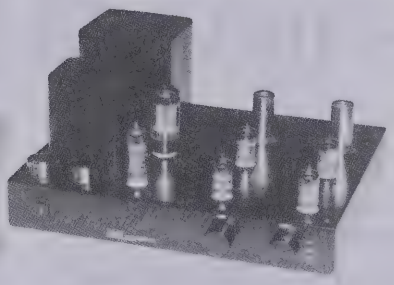
Again, Mr. Rhodes makes a valid point. If you do not want to take any risks for higher performance (minimum THD), then you should always operate at the lowest possible plate dissipation that achieves your target performance.

ARRAY OF AMPS

Since I started listening to tubes in the early '90s, I have built a number of amplifiers, the very first being two modified mantel radios using a 6BD7 input driver and a 6AQ5 output tetrode. I later modified them to triode operation and replaced the 6BD7 with a 12AX7. I have also tried different levels of overall feedback, but finally settled for no feedback at all with very good results.

The sound of this amplifier is not much different from the EAR 859, except for the

Radii audio



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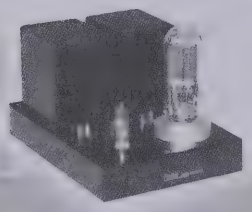

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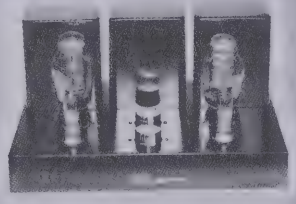

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Reader Service #18

smaller output power, slightly less bass, and less hardness in the treble. Yes, I have built the Tim de Paravicini-designed EAR 859 Enhanced Triode mode amplifier (as described in *Hi-Fi News and Record Review*, pp. 34-37, November 1994).

I even went so far as to order and import from England the original output and power transformers. It took me three years to get the transformers to finally finish the amplifier. [Esoteric Audio Research, Rectory Farm, Godmanchester, Huntingdon Cambs. PE18 8BP England UK.] I used the highest-quality components, including paper in oil coupling capacitors and a motorized ALPS volume control for remote-control operation. This amplifier uses the EL509 (6KG6A) TV-sweep pentode tube to give 13W/channel in Class A single-ended Enhanced Triode mode.

Firing up this amplifier for the first time was a shock to the system. I have previously built a number of push-pull amplifiers using 6BQ5s, 6CA7s (both in single and parallel push-pull), and 6L6s, but the EAR 859 sounded almost worse than any of these. There was no bass and a hard cutting edge to the treble.

I allowed the amplifier to run in for a couple of days, which made a world of difference. It had good bass, a very good midrange, but the treble still has an edge—ever so slight—to it. This 13W single-ended sure has some punch and drive and can go very, very loud. Despite its very wide and fairly deep sound stage, there still seems to be something lacking.

From personal experience, I believe that feedback could be the cause and could even be affecting the treble edge. Feedback seems to push the sound stage further back to behind the speakers and make the mid and treble sound slightly thin. The EAR 859 is a very good amplifier, but it certainly does not sound as good or as involving as does a true triode with no feedback.

I built the "Single-Ended Glory for Under $100" amplifier by Eric Barbour (*GA* 3/95) for a friend. Using a 45 and 6SN7, this is a simple amplifier with that magic triode sound.

I have just finished building the "Kismet: A Simple 2A3 SE Amp" by Fabio Camorani (*GA* 6/96). This requires a 2A3 and 6922 Sovtek (6DJ8), but I didn't have a 2A3 at hand, so I used a 6B4G (same as a 2A3 only it has a 6.3V filament and uses an octal socket). I had on hand two high current 6.3V filament transformers, which I used on the 6B4G; but since they weren't center-tapped, I needed to use a pot on each filament to get the lowest hum, which has worked very well. However, I

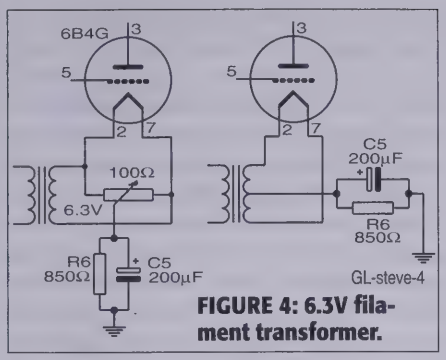

FIGURE 4: 6.3V filament transformer.

wonder whether the sound quality is affected by using a center-tapped filament transformer (*Fig. 4*). Has anyone any experience with this?

Anyway, the "Kismet" is a very fine-sounding amplifier, but, I can't help wondering whether a different driver tube would improve the sound even further.

In the same issue, Eric Barbour describes the 76 as a very good triode ("Letters," p. 64). Would the 76 be suitable to drive the 2A3 as in the "Kismet"?

I know that the 76 is a much lower gain triode than a 6922 or even a 6SN7, but that does not bother me if the 76 could provide a better sound at lower distortion. I have a very high-output CD player that could allow me to run directly into the 76 without a volume control in the way. Eric Barbour also states that the 76 should be capacitor-coupled on the input. My CD player has a 4.7µF capacitor on its output. Does this mean that I can do away with the input capacitor and have my CD player straight onto the grid?

Would the circuit shown on p. 64 be suitable for this application in the Kismet?

The EAR sounds like a high-quality amplifier, while the Kismet (and Eric Barbour's "Single-Ended Glory for Under $100") sounds like a musical instrument giving all the fine texture of real music, which is an emotional experience!

Michael Stevenson
Port Macquarie, NSW, Australia

VT MODELING

I was a little surprised by Don Jenkins's article ("Measurement of AC Plate Resistance," (*GA* 4/98, p. 18), and would like to comment as follows.

It is evident that the first-order model used for vacuum-tube analysis is valid only for the bias point and its vicinity. In other words, at the bias point, we replace the real tube characteristic with its tangent. This first-order model is universally used and is very handy for fast and, most of the time, sufficiently accurate electronic circuit design. To use it, we need only the classical parameters derived from the static tube characteristic and nothing else.

Nevertheless—and I agree with Don Jenkins's assertions—this first-order model has the following serious limitations: It is inadequate for harmonic-distortion evaluation, and inaccurate with large parameter variations around the bias point. To solve this difficulty, and instead of proposing hypothetical new classical parameters, as suggested by Don Jenkins, it would be better to use an analytical function describing with accuracy the tube characteristic. If this suggestion were out of the question in the past, it causes no particular problem today, with our powerful software and computers, except in making the right choice for the analytical function.

The tendency for vacuum-tube modeling, as reported regularly in *Glass Audio*, is to use an arbitrarily modified Child-Langmuir's equation with adjustable parameters determined to get a good fit of the tube characteristics, according to a standard error and a correlation coefficient.

Unfortunately, this popular method is

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6AL5	6JZ8	30AE3	5881
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6AU6	6SA7	35W4	6146A/B
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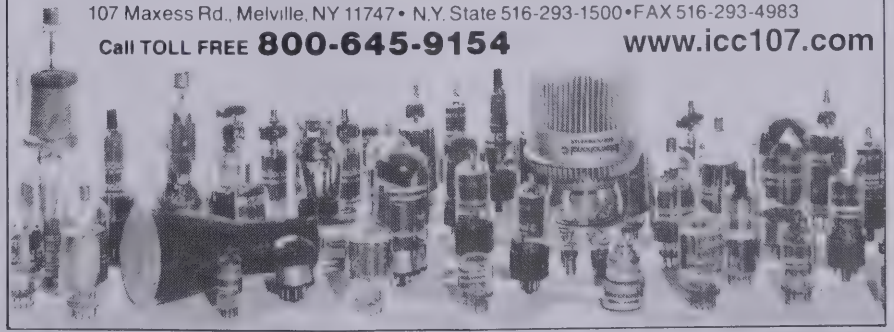

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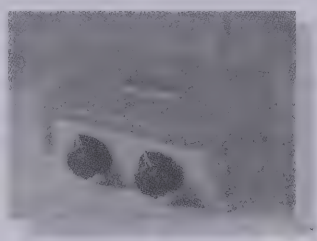

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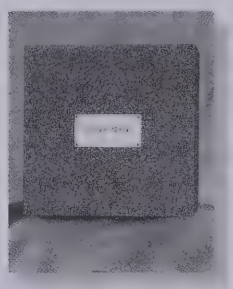

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Reader Service #39

absolutely inadequate and very dangerous from a mathematical point of view. To allow THD evaluation and optimization, the proposed tube model must also have all its n order partial derivatives in accordance with the real ones. But, of course, this is another story.

So, it is time now for scientific people to help properly solve this difficult question, using the safest (but perhaps not easiest) way to find exact analytical or numerical solutions to the partial differential equations, describing the plate current, space charge, and electric field for a given internal tube geometry, grid, and plate voltages.

P.J. Touzelet
Velizy, France

Don Jenkins responds:

My thanks to Monsieur Touzelet for his interest in my article. His observations on the need for better modeling of tube characteristics is certainly valid. His suggestion that these models need to be based on "first principles" is obviously the ultimate model.

I presume that the "hypothetical" new parameter to which Monsieur Touzelet refers is my suggestion to use a grid-plate transconductance value based on an RMS calculation, for a specific grid bias swing, rather than the value calculated by the static-tangent method. My primary purpose was to show that for tube applications in which the grid was expected to swing between zero bias and to almost cutoff, in some cases the use of a constant, mid point, static-tangent derived value would not be satisfactory for high-performance designs, specifically, for the new higher-power triodes.

Relative to performance modeling, Monsieur Touzelet may be interested in my approach which is available from Audio Amateur as the TubeMap0 disk. This approach is based, not on first principles, but on actual measured tube performance. I use at least ten tubes, presumably a random selection from production lots, for the data development. A large number of plate-current/grid bias transfer functions are developed over the useful range for application.

Most tubes require third-order functions to adequately fit the true performance. These functions are then used to derive any specific operating point, or any range of operating points. However, even with the use of third-order transfer functions, convergence is sometimes difficult, for low plate-current points. The model also produces transconductance and plate-resistance (AC) values.

However, several problems undoubtedly exist with this approach, as well as with a first principle mode. The major source of uncontrollable error in any model output results

from tube-to-tube and lot-to-lot performance dispersion due to the tube production process.

The TubeMap model attempts to provide an estimate of the model error for each performance point calculated, the error being determined from the dispersion data derived from the tube samples. In some cases, particularly the cutoff tail, i.e., the low plate-current regime where the plate-current value approaches zero, these dispersion errors can be quite large.

Even with the use of a first principle model, assuming that it could be described with exact precision, the existence of manufacturing variations would result in these same errors when calculating real tube performance. This is not to suggest that such a model would not be useful, but to simply point out that even the most rigorous model will suffer errors generated from unavoidable manufacturing tolerances, in many cases the errors will be greater than the increased precision obtained from more rigorous modeling.

Thanks again to Mr. Touzelet for his comments. I hope his suggestions will increase interest in vacuum-tube modeling.

A HISTORY LESSON

I was intrigued by the "Glass Shard" from reader Alberto Carmelini showing a 1960's circuit for a low-power audio amp (*GA* 3/98, p. 66). As a student of audio circuit design since when tube theory was still taught in college EE courses, I looked at this circuit to understand what the designer was trying to do. This is a very interesting, innovative circuit!

If you redraw the circuit (*Fig. 5*) you get a sense of what the designer was trying to accomplish. Now you see a more conventional two-stage amplifier, but also clearly showing the direct coupling of all tube elements from the circuit input to the output transformer primary. Further, the input 6SJ7 screen voltage is supplied from the output stage cathode circuit with current feedback.

There is some additional feedback (positive in this case) from the cathode of the output circuit to the plate of the input tube. Both of these feedback paths probably were intended to help overcome the output transfomer/speaker deficiencies, but establishing the 6SJ7 screen voltage without additional components, with direct coupling and feedback is very clever circuit design! This is a very good design from the renaissance of circuit design from which we all can learn.

Ronald Murphy
Los Altos, CA

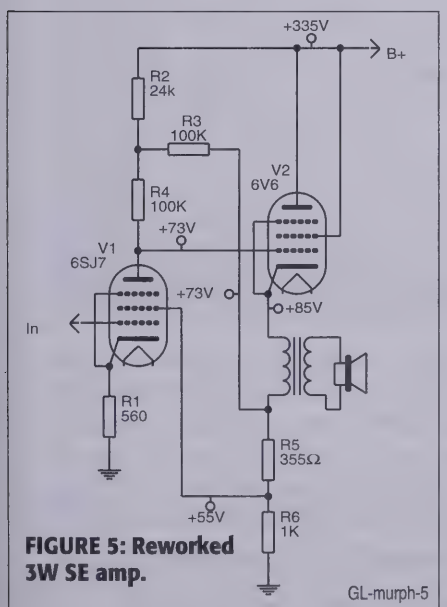

FIGURE 5: Reworked 3W SE amp.

A REFRESHING APPROACH

I enjoy Larry Lisle's different approach to tubes and electronics ("Canceling Harmonics in SE Amplifiers," *GA* 5/98, p. 30).

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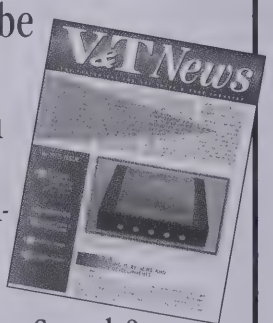

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HELP WANTED

As a new subscriber, I am enjoying my first issue of *Glass Audio*; I hope to discover, among other things, a rich vein of eccentricity!

I wonder if any *GA* readers out there possess a set of triode curves for the 813? These would save me the severe risk of trailing 1kV+ cables across the floor!

Paul de Raymond Leclercq
Paul.Leclercq@tnsofres.com

We are busy repairing an old Philco radio, b + w models B3101 and B23101. Does anyone have a schematic diagram for this unit? Serial number is AZ 10635.

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Readers with information on this topic are encouraged to respond directly to the addresses provided.-Eds.

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Chris Ossanna
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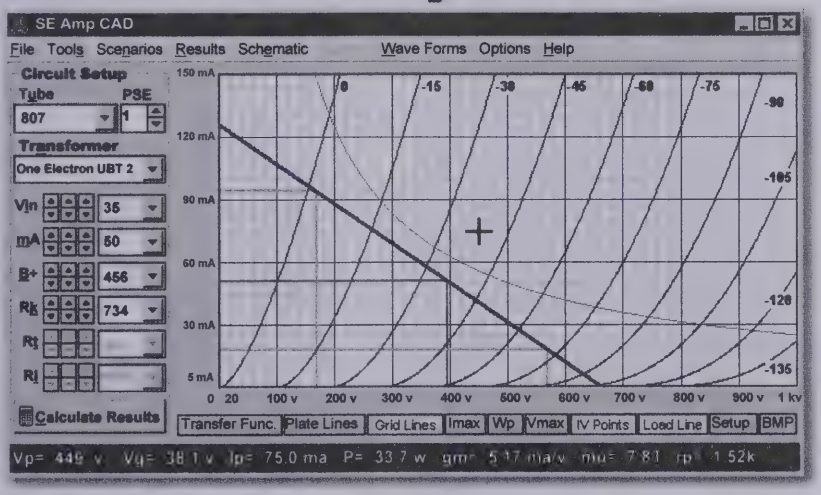
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Reader Service #101

EDISWAN HI-FI AMPLIFIER

I saw this hi-fi Mazda amplifier circuit (*Fig. 1*) in a 1935 valve manual. Phase splitting arrangements are similar to those used by Quad. Parts are available to construct it using a modern custom-wound output transformer. Note the circuit is not easily duplicated due to the impossibility of finding PP3/250 or PP5/400 output triodes, therefore, you must have a stash on hand. The PP4/500 was used in the 1930s—built as a post-office speaking clock, believe it or not, and was in service until the '60s. Hence the small number of PPs.

Philip Taylor
W. Sussex, England

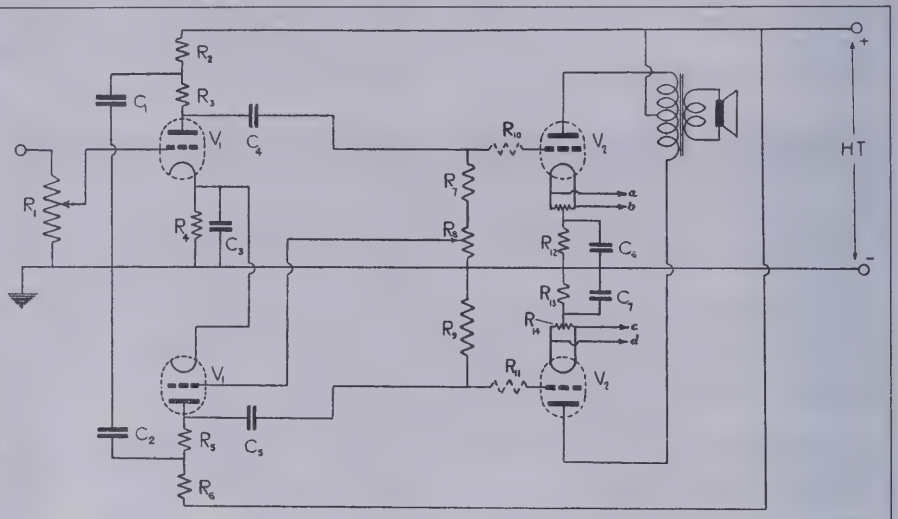

FIGURE 1: 1935 Mazda amplifier circuit.

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Reader Service #59

PILOT AA-901

The Pilot classic triode amp (*Fig. 2*) is a rare bird indeed. It was reasonably priced, but never sold well since the company tended to pursue the mid-fi market. It features a Williamson design with triode-connected KT66s. The output transformer is supposed to be extra-special from a performance standpoint, but never having seen one or heard of anyone having one, I can't say more. The AA-904 is supposed to be very similar but an ultralinear version.

Eric Barbour
Regular Contributor

NOTES FOR TABLE 1

1. DC voltage measurements are at 20kΩ/V; AC voltages measured at 1kΩ/V.
2. Socket connections are shown as bottom views.
3. Measured values are from socket pin to common negative.
4. Line voltage maintained at 117V for voltage readings.
5. Nominal tolerance on component values makes possible a variation of ±15% in voltage and resistance readings.
6. All controls at minimum, proper output load connected.

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TABLE 1
RESISTANCE READINGS

ITEM	TUBE	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8
V4	6SN7GT	†100kΩ	†53kΩ	27kΩ	470kΩ	†100kΩ	470Ω	23Ω	23Ω
V5	6SN7GT	680kΩ	†50kΩ	470Ω	680kΩ	†50kΩ	470Ω	23Ω	23Ω
V6	KT66	58Ω	23Ω	†200Ω	†280Ω	111kΩ	110kΩ	23Ω	300Ω
V7	KT66	14.5Ω	23Ω	†200Ω	†280Ω	111kΩ	110kΩ	23Ω	300Ω
V8	5U4G	INF	41kΩ	INF	37.5Ω	INF	41.5Ω	INF	41kΩ

† Measured from Pin 8 of V8

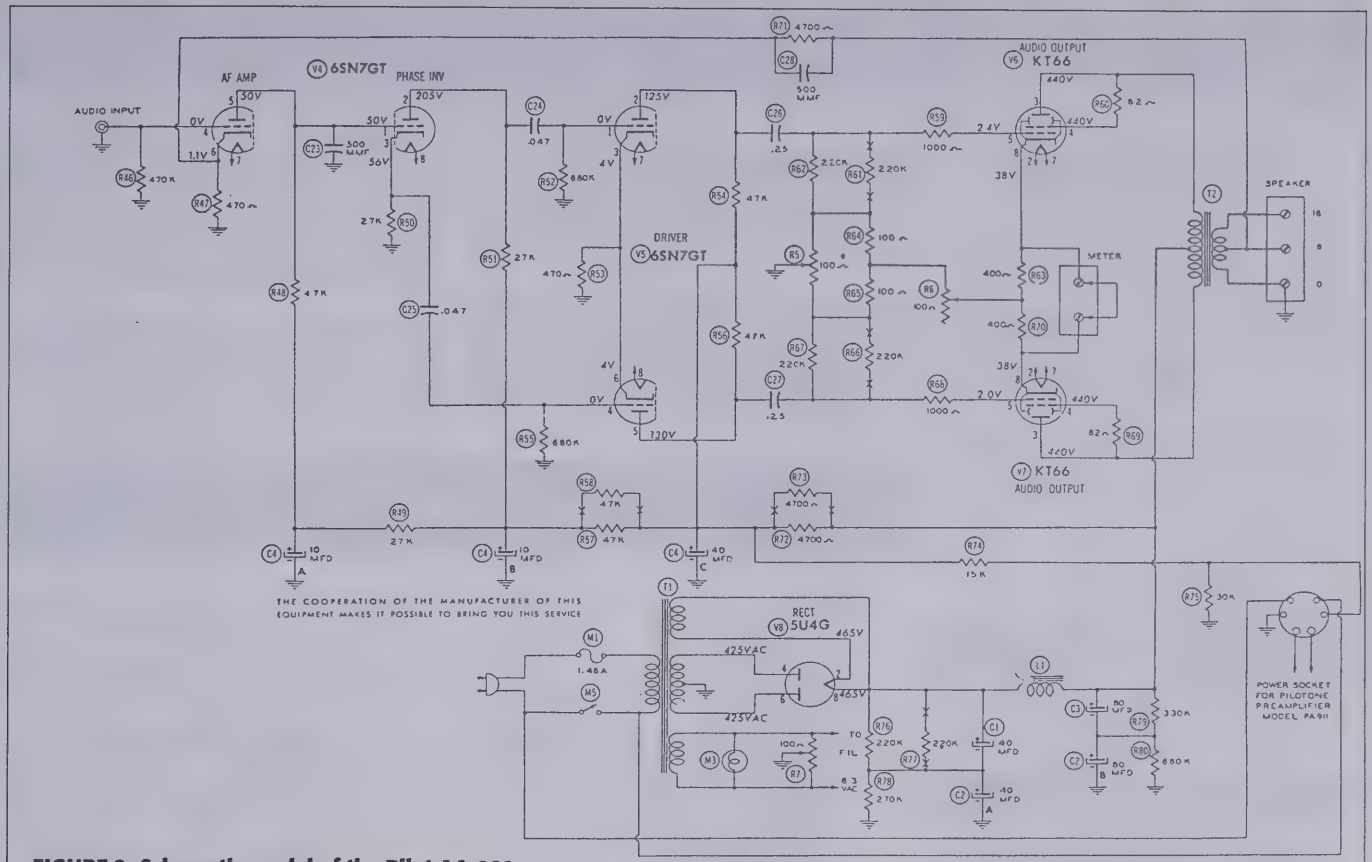

FIGURE 2: Schematic model of the Pilot AA-901.

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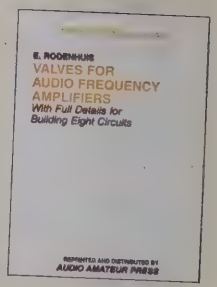

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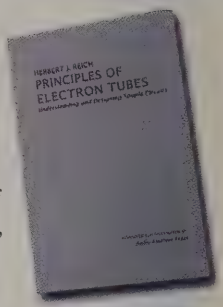

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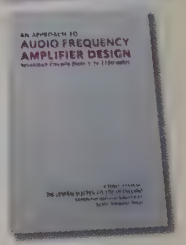

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GLASS SHARDS

INTERSTAGE TRANSFORMERS

Western Electric engineers had their hands full designing power amplifiers for a growing nation. Today the 205-D is a rare tube, but in the past, 205-series tubes were used in push-pull theater amplifiers, as well as providing duty as rectifier tubes in the WE amplifier power supply (*Fig. 1*)! Of special interest is the use of the 233-H interstage transformer (IT) to provide inverting and noninverting signals to the output tubes. The WE engineers used the old trick of cap-coupling the interstage transformer to eliminate DC core saturation in the 233-H by the 239-A driver tube—very clever.

I have been experimenting with a similar stage-coupling configuration on my recently completed 211 amplifier, using the AES/Thordarson 20-D-89 interstage (7kct primary 15kct secondary), which I have used in previous amps; however, the rolloff is excessive in the lower frequency range when used as a driver transformer, and the top end is excessive and bright.

These transformers are prone to ringing and are good candidates for snubber circuits or other trickery when used as an interstage. I hesitate using this transformer as a single-ended, driver-plate load, despite the advertised 40mA rating. Cap-coupling the interstage removes the DC component, which is necessary when experimenting with small interstages. You could reason, however, that this makes sense only when driving push-pull grids; single ended use could be cap-coupled and eliminate the transformer altogether. Sometimes an IT is used to provide higher grid swing voltages than those ordinarily available from the driver stage. When experimenting with new or used interstage transformers, your best bet is to strap one on and see how it performs.

Early schematics contain a wealth of information, and can really humble a person when you consider that in many cases, these were the first examples of this technology. Today, perhaps the only thing more scarce than original 205D "tennis ball" tubes were the output and interstage transformers used by Western Electric. ITs have been used for decades, and as the saying goes, "We walk in the footsteps of giants."

Chris Wolf
Murrieta, CA

BALANCING HEATERS

Many vacuum-tube amplifiers use either high-current triodes or large TV horizontal output tubes in quantity. When these are operated from a 6.3V heater supply, you may find difficulty in achieving a balanced output. Things go downhill quickly as the number of tubes in this part of the circuit increases.

You can sometimes trace the problem to the heater wiring connected to these tubes. If they are wired simply in an ordi-

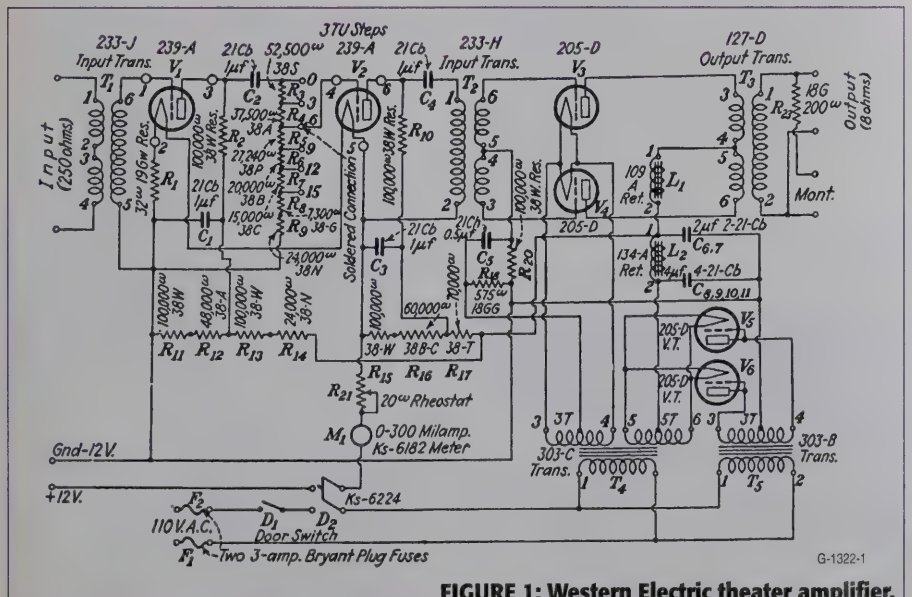

FIGURE 1: Western Electric theater amplifier.

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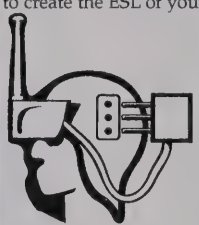

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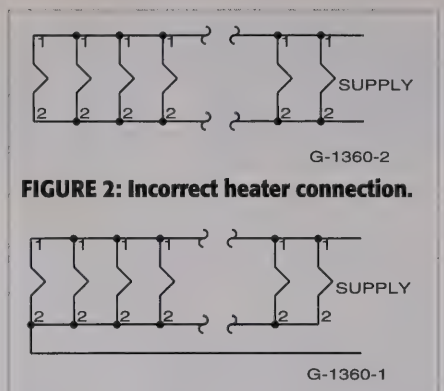

FIGURE 2: Incorrect heater connection.

FIGURE 3: Correct heater connection.

nary parallel-fed connection (*Fig. 2*), the last tubes in the string may run with cooler cathodes than those at the beginning. A simple connection (*Fig. 3*) will avoid this nuisance because it ensures that all tubes will see the same heater supply.

John Stewart
King City ON

AN OLD FAVORITE

The old venerable 6AS7G can turn out some marvelous sound. My 2A3s and 6B4Gs cannot better it, let alone equal it. It has all of the attributes of a good audio tube, and I don't know why it hasn't been used more. Perhaps because there have not been good audio specs published.

I looked up data on the 6AS7G and discovered that in 1949 one manufacturer had listed some good conditions to use it as a power amp, which are: 375 plate volts, 250V to cathode; self bias of –125V works into a 1500Ω load. Couple this with a parallel plate feed through a 20H choke, and you have the most beautiful music.

That's for only one section of the 6AS7G. Parallel the two sections for about 6W out, and lower the plate load to 1000 or 1250. It drives nicely from a cascaded 6SN7 preceded by a 6SL7 as a tone control stage.

George David
Lincoln, NE

SRPP WITH INDUCTIVE LOAD

Experimenting with the SRPP stage, I decided to try out the following topology, which I have not come across elsewhere (*Fig. 4*). The idea is to replace the resistor between the upper and the lower valve with a coil. Listening to this setup, I was startled to find that compared to the traditional SRPP configuration, sound production was far superior. There was a tremendous amount of easily identifiable detail with background instruments, a broader soundstage, and a noticeable absence of any effects tiring the listener.

One explanation for this phenomenon is that the lower valve sees no load except at very low frequencies. The internal resistance of the coil should, of course, match the value of Rk to bias the upper valve correctly, approximately 1k for B+ at 250–300V. Adding to the resistor in series with a coil of insufficient resistance to bias the upper valve correctly deteriorates sound quality. As to the inductive reactance of L, it seems that the higher the value the better. I ended up using a high-quality coil of 8.2H. Bypass capacitor Ck was 470μF.

I noticed two things on the test bench. First, replacing the resistor with a coil reduced distortion by more than a half (<0.2% as opposed to >0.4%, both @ 1000Hz and 3V RMS output), a figure I am confident could still be improved. Distortion consisted almost entirely of second harmonics.

Second, the perfect square-wave response of the traditional SRPP configuration deteriorated somewhat, as you might expect, with a minute ringing at the leading edge and a slight tilt because frequency response was down by 2dB at 20Hz but otherwise flat to 200kHz. Adding R2 (approximately 5–10k) took care of the ringing, and the low pass R2/R3/C1 can be designed to even out the low-frequency response. In my case, however, switching R3/C1 in and out of the circuit while listening to the amplifier made no audible difference. In both cases, bass was very impressive. ❖

Christian Wildberg
wildberg@princeton.edu

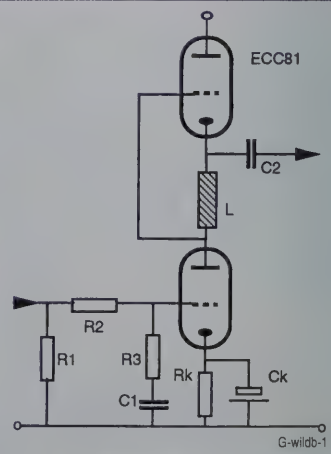

FIGURE 4: A different SRPP configuration.

Glass Audio BACK ISSUES

1988 An Electrostatic Headphone Amp ✦ Self-Bias Servo for Push/Pull Amps ✦ Greening the G36 ✦ Stereo Microphone Preamp ✦ Dynamic Headphone Amp ✦ **wt: 1 lb.**

1989 ST-70 With Solid-State Regulation ✦ Vacuum Tube Denon CD ✦ Restore Your Scott Tuner ✦ UK Round-Up ✦ Tube Directory ✦ Rejuvenating Dyna's Mark IV ✦ Soft Start for Tubes ✦ Transformer Hunting ✦ Looking at Vacuum Tube Rectifiers ✦ Extending Tube Life ✦ **wt: 1 lb.**

1992 A High Quality Vacuum Tube Voltage Regulator ✦ How Transformers Work ✦ Modifying the ST-70 With Triode Mode ✦ Controlling Snap! Crackle! Pop! ✦ The Fender Amp Champion ✦ Vacuum Tube AC Feedback Amps ✦ Electrical Adjustment Fitting a Transformer ✦ An Octal Tube Preamp ✦ Applying Vacuum Tube Op Amps ✦ Tube Circuit Primer: A Reference ✦ Purist Tube Amp ✦ 65W Triode OTL Power Amp ✦ Tubes vs. Transistors ✦ Low Dropout Filament Voltage Regulator ✦ **wt: 2 lbs.**

1993 A 40W Class A Triode Amplifier ✦ Overlooked Tube Bargains✦ Tubesaurus Rex ✦ Is the 6DJ8 Suitable for Audio? ✦ Professional Tube Line Driver ✦ The Mu Stage ✦ Custom Tube Electronic Crossover, Pt 1-2 ✦ Resurrection for Lazarus ✦ Vacuum Tube Regulator Design ✦ Feedback RIAA Equalization ✦ A Nuvistor Preamp ✦ Balanced Tube Alternatives ✦ Vacuum Tube Models for PSPICE Simulations ✦ **wt: 2 lbs.**

1994 Transformer Coupled WE-300B Single-Ended Amp ✦ A Tube DAC ✦ Dual 1 + 1 Cascade Amplifier ✦ Cascode Construction ✦ A New Dynaco PAS Upgrade ✦ Amending Brian Lowe's Servo Bias System ✦ Output Transformers, Pt 1-2 ✦ A Purist Tube-Regulated Supply ✦ An Amplifier Soft-Starting Control ✦ Differential Series Feedback Pair ✦ Inside the Russian Tube Industry ✦ A Headphone Helper ✦ Importance of Balance in Push-Pull Amplifiers ✦ Rectifying Your Drivers ✦ Purist Tube-Regulated Power Supply, Pt 1-2 ✦ **wt: 2 lbs.**

1995 A Vacuum Tube Op Amp ✦ A Quality Preamp Power Supply ✦ More Phase Splitters ✦ Making Contact With Your Tubes ✦ Quick, Simple Output Transformer Tests ✦ Peak Reading Level Meter Using Indicator Tubes ✦ A 15W Triode Power Amplifier ✦ Guitar Amp Refinements ✦ Single-Ended Glory for Under $100 ✦ The Suitability of the 6DJ8 for Audio ✦ The Snubber ✦ Exploring the Balance in Tube Pairs ✦ The AES SE1 Modification ✦ Soft-Start for Power Tubes ✦ Brute Force in a Line Stage ✦ Small-Signal Pentodes for Audio ✦ Diff Amp Driver with BJT Source ✦ A Balanced Input Phono Preamp ✦ An Old-New Bias on Bias ✦ Transmission Line Audio Transformers ✦ Playing with Curves ✦ The Greening of the Cascade Feedback Pair ✦ Russian Tube Designators ✦ A Grounded Grid Line Stage ✦ Reconstructing Older Amps ✦ Distortion in Small Signal Triodes ✦ The Amplifier Distortion Story, Pt 1 ✦ Linear Output Stages ✦ Build a Triode-Pentode Local Feedback Control ✦ The 6DQ Single-Ended Power Amp ✦ PRODUCT REVIEW: The McIntosh C-22 Stereo Preamplifier ✦ **wt: 2 lbs.**

1997 The Country Boy's Capacitor Microphone ✦ Driving the 300B ✦ Distortion in Tubes, Pt 2 ✦ The Amplifier Distortion Story, Pt 2 ✦ Collecting Glass--An Overview ✦ A Single-Ended Pentode Amp ✦ In Search of the Perfect Tube ✦ We Talk with Dennis Had ✦ A Differential Amp for Electret and Electrostatic Headphones ✦ Triode vs. Pentode: Which? ✦ The Stereo Half-Watter ✦ A Single-Ended SV811-10 Amp ✦ Dual Single-Ended Amplifier ✦ EZ Start Power Controller ✦ KIT REPORT: Velleman 100W per Channel Stereo Valve Amp ✦ Harmonic Cancellation Improves the SE Amplifier ✦ A Tube Designator Glossary, Pt 1-2 ✦ Yes, You Can Substitute for the 7591 Tube! ✦ Quality Testing for Audio Amplifiers ✦ Vacuum Tube Electronics, Pt 1: The Classic Texts ✦ Vaccum Tube Electronics, Pt 2: Specialized Titles ✦ A Russian/Western Tube Chart ✦ Measuring Circuit Impedances ✦ A 15W SE Power Amp with 6C33C-B ✦ Improved Vacuum-Tube Models for SPICE Simulations ✦ Direct-coupled Mu Stage ✦ World Class Fit and Finish ✦ Filament Power and Performance of the 2A3 ✦ Enhanced-Mode Operation ✦ KISMET: A Simple 2A3 SE Amp ✦ A Triode Minimalist Crossover ✦ Ultra-Low Distortion Graphic Equalizer ✦ The Search for Linearity, Pt 1 ✦ A New Transmitting Tube Driver Stage ✦ KIT REPORT: The Arion Adonis Amp Kit ✦ BOOK REPORT: Digital Projects for Musicians ✦ PRODUCT REVIEW: The BK Power Amps ✦ **wt: 3 lbs.**

1997 4-250A Beam Tetrode Power Amplifier ✦ Distortion in Tubes ✦ Differential Line Amp with Tubes ✦ The Search for Linearity, Pt 2-3 ✦ Vacuum Tube Electronics, Pt 3: Circuit Theory ✦ SPICE and the Art of Preamplifier Design, Pt 1-2 ✦ High-Performance Tubed DAC Output Stage, Pt 1-2 ✦ An MC/MM Preamplifier ✦ Big Mother Power Supply ✦ PRODUCT REPORT: Radiotron Designer's Handbook on CD-ROM ✦ Transformer-Coupled SE Amp Revisited ✦ Optimizing the 2A3 Performance ✦ Simple Gain Circuits (from Beginner's Guide to Tube Audio Design) ✦ A Battery Tube Hi-Fi Amplifier ✦ SE Amplifier Output Impedance, Pt 1-2 ✦ Sound of the Machine: The Hidden Harmonics Behind THD ✦ WWII "VT"/Generic Conversion Tube Chart ✦ Current-to-Voltage Converter for CD Output ✦ Improving the SV811-10 Amplifier ✦ A Behemoth Tamed ✦ A Better Tube Tester ✦ PRODUCT REPORT: 3M's Tube and Chassis Damping ✦ A Survey of Audio Preamp Tubes ✦ Electrolytic Capacitor Reforming Unit ✦ KIT REPORT: Single-Ended Experimenter's Kit ✦ BOOK REPORT: Beginner's Guide to Tube Audio Design ✦ **wt: 3 lbs.**

1998 Low-Voltage Tube/MOSFET Line Amp ✦ An Audio Tube Tester ✦ Dual Single 300B Stereo Amplifier ✦ *GA* Bottle Baby ✦ Transformation of the AR Turntable ✦ 40W Triode and 60W Ultralinear Amplifier ✦ Will the Real 300B Please Stand Up? ✦ A PSpiced Preamp with THD Cancellation ✦ Algebraic Technique for Modeling Triodes ✦ An Ihset Amplifier ✦ Ripple Reduction in Full-Wave CT Power Supplies ✦ Try Battery Tubes ✦ Smart Soft-Start and Standby Circuit for Tube Amplifiers ✦ Feedback—Head Cook and Bottle Washer! ✦ Vacuum-Tube Electronics: Part 4—Electromagnetics & Tube Physics ✦ The Beta-Follower Amplifier ✦ 300Bs on Test ✦ Futterman Headphone Amplifier ✦ Measurement of AC Plate Resistance ✦ Vacuum Diode Models & PSPICE Simulations ✦ Build the FAB 50 Line Stage ✦ Canceling Harmonics in SE Amplifiers ✦ 70W Low-Distortion Triode Amplifier ✦ Direct Coupling the EL509 ✦ Product Report: The Wright Sound WPL-10V ✦ Book Reports: *The Tube Amp Book; Music, the Brain, and Ecstasy* ✦ A 24-bit DAC ✦ The Power Tube, Pt 1-2 ✦ Cascode Power Amplifier Circuits, Pt 1-2 ✦ Heater Care and Feeding ✦ Kit Reports: Atma-Sphere M-60 Mk. II, Assemblage ST-40, Miyabe VP300BD Stereo Amplifier Kit ✦ **wt: 3 lbs.**

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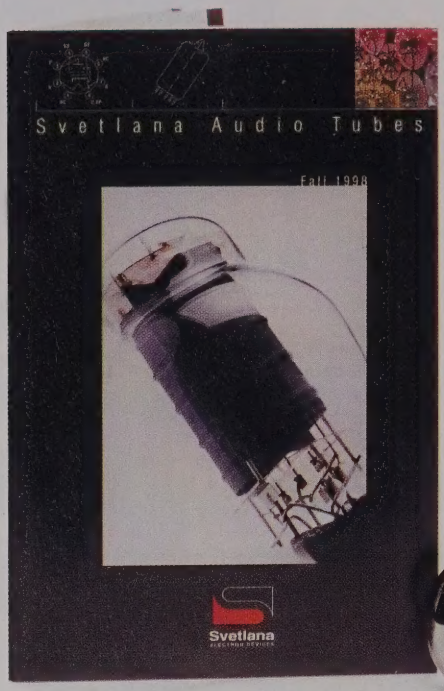

TUBE CATALOG AND WEBSITE

Svetlana's 1998 audio tube catalog features detailed technical specifications and performance curves for each Svetlana tube. Whether you are buying new tubes for your amplifier or are an OEM designer, the catalog is a complete reference for the entire Svetlana audio tube line.

The company also invites you to browse its improved website at www.svetlana.com. It features data sheets on Svetlana products that are downloadable in Adobe Acrobat format, online help and technical support, and a list of related websites. Svetlana Electron Devices, Inc., 8200 S. Memorial Pkwy., Huntsville, AL 35802, (256) 882-1344, FAX (256) 880-8077, E-mail info@svetlana.com.

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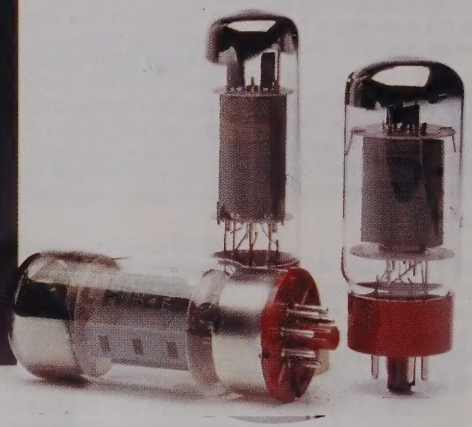

CUSTOM BOXES FOR YOUR TUBES

SpireAudio offers two types of enclosures for tube amps and preamps. The "clam shell" was designed for electronic projects that have all the components mounted internally. For those with tubes and transformers mounted on the top, the company offers a design that is a six-sided box with a removable bottom plate. SpireAudio Enclosures, 2601 Louisiana St., Sacramento, CA 95821, Voice/FAX (916) 481-3056, E-mail spire@spireaudio.com.

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HEAVY TUBE READING

Tube Substitution Handbook, revised edition, by Barry Buchanan and William Smith, is a useful guide for antique radio buffs, classic car enthusiasts, and ham operators. It consists of three sections: Vacuum Tubes; Picture Tubes; and Tube Basing Diagrams, which provide references to pin numbers for the tubes listed in Sections 1 and 2. PROMPT® Publications, (800) 428-7267.

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sound valve™'s factory catalog includes products such as the M40i and M60i tube monoblocks, the VTA70i stereo tube amp, and more. sound valves, 185 N. Yale Ave., Columbus, OH 43222, (614) 279-2383, FAX (614) 279-0368.

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Website www.audiocafe.com features thousands of home-stereo records, computer audio, and home-theater products. The site also offers daily reports of new products and developments, and weekly audio-streamed interviews with influential figures within the audio industry.

TUBE WEEKEND

Vacuum Tube Valley's Tube Enthusiasts Weekend will be held February 27–28. Saturday will feature the class, "VTV Practical Tube Audio for Hi-Fi & Guitar Amplifiers." It is designed to give you practical knowledge about vacuum tubes, amplifier applications, and how to achieve the best sound. Sunday will feature the Southern California Hi-Fi and Record Swap Meet. Vendors will have NOS tubes, new and vintage audio gear, tube guitar amps, parts, books, speakers, transformers, and more. Vacuum Tube Valley, PO Box 691, Belmont, CA 94002, FAX (650) 654-2065, E-mail triode@vacuumtube.com.

NOS ACQUISITION

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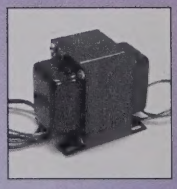

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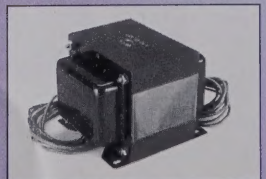

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